HIGHLIGHTS

REVISION NO. 33 Jun 01/10

Pages which have been revised are outlined below, together with the Highlights of the Revision

CH/SE/SU C PAGES	REASON FOR CHANGE	EFFECTIVITY
CHAPTER 73		
L.E.P. 1- 6	Revised to Reflect this revision indicating new,revised, and/or deleted pages	
T. OF C. 4	Revised to reflect this revision	
73-12-01 405- 408, 412- 416, 419- 424	Minor additions and amplification REVISED INSTALLATION PROCEDURE TO SPECIFY MINIMUM LOOSENING TORQUE LIMIT FOR TUBE FM11.	
73-12-49 407- 408	Minor additions and amplification REVISED INSTALLATION PROCEDURE TO SPECIFY MINIMUM LOOSENING TORQUE LIMIT FOR TUBE FM11.	
73-23-00 404, 407	Minor additions and amplification REVISED INSTALLATION PROCEDURE TO SPECIFY MINIMUM LOOSENING TORQUE LIMIT FOR TUBE NUTS.	
73-25-00 35, 46- 92, 95- A 01,A 05- A 09,A 11- A 29,A 31, A 34-A 44, A 49,A 59- B 08	Effectivity updated at the bottom of the page SB 73-2030 incorporated ENGINE FUEL AND CONTROL - PW 4000 ENGINES -IN TRODUCE FADEC SOFTWARE VERSION SCN IIA/AA Effectivity updated in the text	
73-34-00 501- 502	Layout improved	
73-38-00 11	SB 73-2030 incorporated ENGINE FUEL AND CONTROL - PW 4000 ENGINES -IN TRODUCE FADEC SOFTWARE VERSION SCN IIA/AA Effectivity updated in the text	
73-38-00 512- 514	SB 73-2030 incorporated ENGINE FUEL AND CONTROL - PW 4000 ENGINES -IN	

CH/SE/SU C PAGES	REASON FOR CHANGE	EFFECTIVITY
	TRODUCE FADEC SOFTWARE VERSION SCN IIA/AA Effectivity updated in the text	

CHAPTER 73

ENG. FUEL & CONTROL

LIST OF EFFECTIVE PAGES

N, R or D indicates pages which are New, Revised or Deleted respectively
Remove and insert the affected pages and complete the Record of Revisions and the Record of Temporary Revisions as necessary

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OF TEMP.			
REVISION			
L.E.P.	R	1- 6	Jun01/10
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CHAPTER 73

ENG. FUEL & CONTROL

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ENGINE FUEL AND CONTROL-GENERAL - DESCRIPTION AND OPERATION

1. General

A. Introduction

The function of the engine control system is to provide an automatic regulation of engine power setting corresponding to the environmental conditions, the aircraft demand (throttle control lever position, aircraft power extraction, bleed status, idle control,...) and compatible with the engine operating conditions.
The system also provides diagnostic information which enhances aircraft line maintenance and dispatch readiness by identifying faulty engine components or interfaces with aircraft.

B. FADEC System

(1)Overview (Ref. Fig. 001)

The engine control system is built around a dual channel, Full Authority Digital Electronic Engine Control (FADEC) which interfaces with aircraft and engine control components through three main subsystems (Ref. Fig. 001).

- Electronic subsystem
- Hydraulic subsystem
- Pneumatic subsystem

The FADEC is a fan case mounted, air cooled, vibration isolated engine controller, designed to provide :

- Enhanced basic engine control functions.
  - Starting, idle, acceleration, deceleration, stability, and thrust control.
- Optimized engine efficiency,
  - Maintain and coordinate complex schedules for anti-surge bleeds, variable stator vanes, compressor clearance control, automatic turbine rotor clearance control, cooling airflows and thrust balance venting.
- Integrated engine accessory control.
  - Heat exchanger valves.
- Enhanced engine protections.
  - Critical speed and pressure limiting.
  - Thrust limiting and overboost protection.
- Coordinated engine/aircraft control functions.
  - Accomplished via data communication networks
- Improved pilot/engine interface, relative to hydromechanical control systems.
  - Automatic EPR control, limit protection and diagnostics.
- Improved operational reliability, relative to hydromechanical control systems.
  - Accomplished through dual channel control, automatic fault detection and compensation and reduced down time through enhanced diagnostics.
- Improved engine maintenance.
  - Accomplished through condition monitoring, fault detection and on-board diagnostics.

The FADEC is able to detect its internal failures or erroneous inputs or

outputs, to accommodate these failures, to flag them for maintenance action and to provide aircraft systems with information enabling them to provide a warning if a crew action is required.
All critical paths and functions are redundant. To accommodate the failures, the FADEC is able to use :
- the alternate channel if capable of control
- inputs from alternate channel through crosswire or crosstalk
- outputs to alternate channel through crosstalk
- synthesis input parameters from other source.

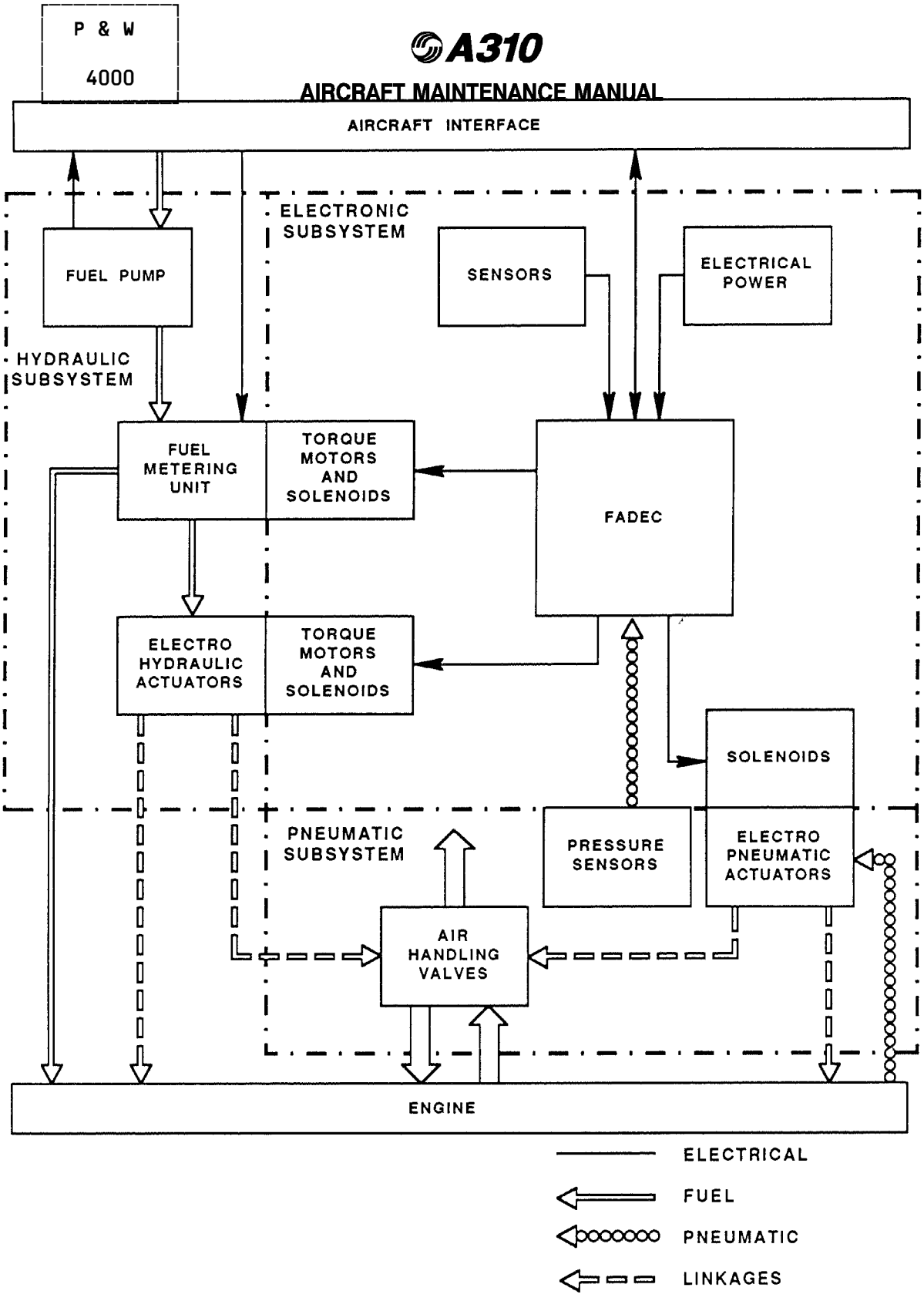
The FADEC system is able to work without any aircraft data or signal, including power supply, with the exception of the throttle control lever position necessary to modulate the thrust.
The primary control mode normally used is the EPR mode. In this control mode THE FADEC contains all the engine thrust setting curves to provide automatic thrust ratings.
In case of inability for the system (after failure) to control in primary control mode, an alternate mode is used : N1 mode. This mode is a non rating mode with the power setting done manually.

(2)Electronic Subsystem (Ref. Fig. 002)
This portion of the engine control system includes :
- The Full Authority Digital Electronic Engine Control assembly (FADEC)
- The dedicated permanent magnetic alternator (PMA)
- The engine related sensors and input signal switches
- Solenoids, torque motor and feedback sensor portions of the system's valves and actuators.
- The electrical harness.

(3)Hydraulic Subsystem (Ref. Fig. 003)
This portion of the engine control is the fuel system itself. It includes :
- The fuel pump,
- The fuel filters,
- The fuel metering unit,
- Th HP fuel shut-off valve,
- The fuel distribution components,
- Actuators using regulated pressurized fuel as muscle source,
- The engine fuel/oil heat exchanger,
- The IDG fuel/oil heat exchanger.

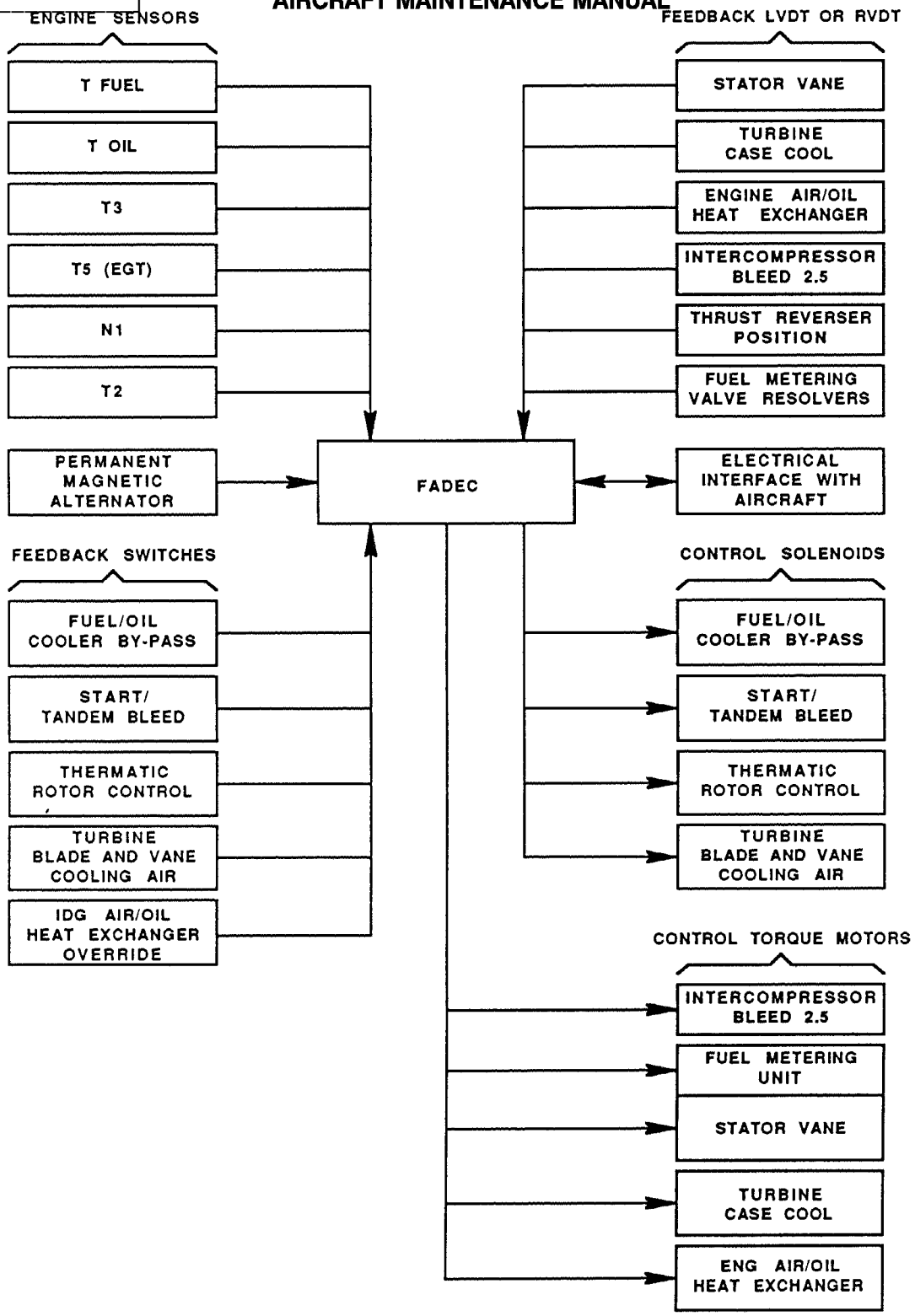
The hydraulic pressure is supplied by the engine fuel pump.

(4)Pneumatic subsystem (Ref. Fig. 004)
This portion of the system includes the air handling valves and solenoid control used in conjonction with engine bleeds, engine thermal control and accessory functions.
It also includes those actuators and valves that use pressurized air as their power source, and the engine pressure sensors.
The pneumatic pressure used as muscle source is the compressor discharge pressure (15 th stage).



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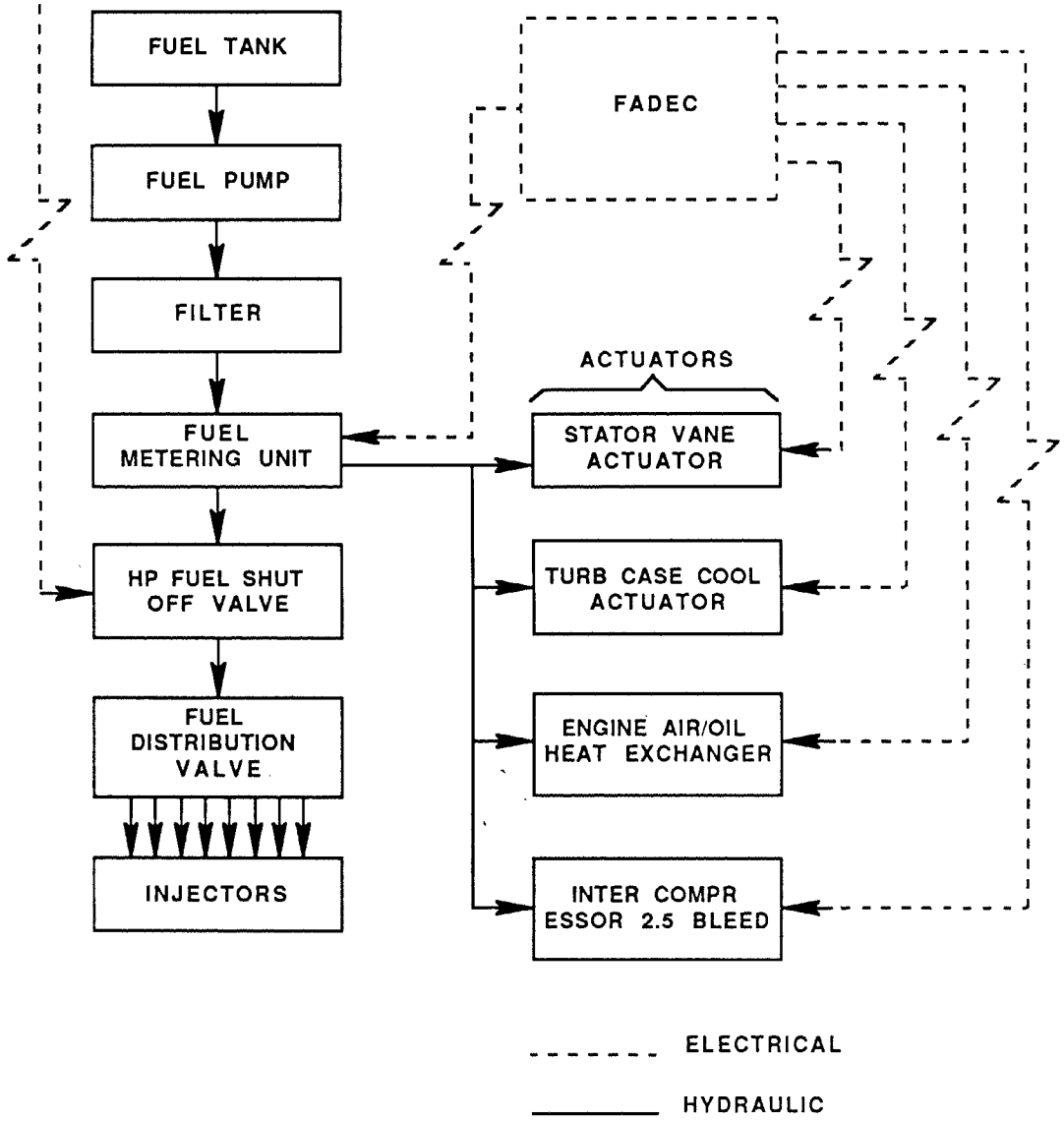
Engine Control System Elements
Figure 001



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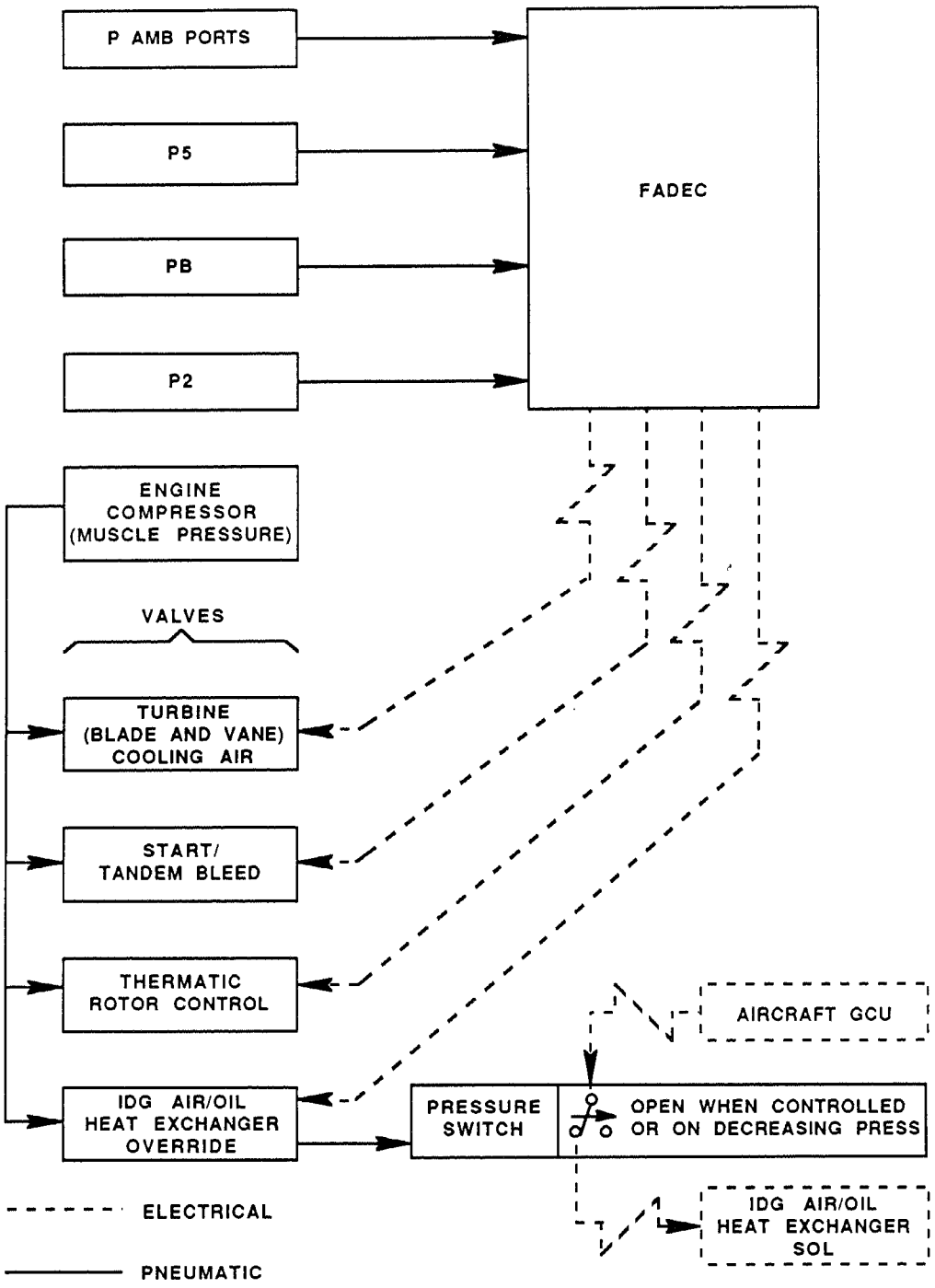
Electronic Subsystem
Figure 002

A/C CONTROL



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DM5

Hydraulic System
Figure 003



Pneumatic Subsystem
Figure 004

2. Operation

A. FADEC System (Ref. Fig. 005)

The FADEC system, which includes the FADEC itself, its engine mounted sensors and the electrical portions of its effectors, working with the fuel system and the hydromechanical positionning actuators provides full range control of the engine to achieve both steady state and transient performances.

The aircraft provides essential subsystems such as throttle resolvers for thrust command and non essential subsystems such as air data, service bleed reset, discrete signals, and electrical power for performance enhancement solenoids and ground test power.

Using this information, the FADEC provides the full range of control required to modulate :

- engine fuel flow,
- high compressor stator vanes,
- low and high turbine case cooling,
- engine and IDGs air/oil cooling,
- 2.5 compressor bleed flow,

These functions are all provided by torque motor controlled hydraulic actuators.

The electronic control also schedules discrete signals for solenoid on/off operation to control :

- engine and IDGs fuel/oil cooler bypass valve,
- compressor starting bleeds,
- high compressor active clearances,
- high turbine vane cooling.

These components are pneumatically controlled by the solenoids.

The FADEC calculates the primary power setting parameters (EPR actual and command).

This information is transmitted to a cockpit indicator for display to the crew.

The functional block diagram, (Ref. Fig. 005) summarizes all the above functions.

To ensure reliability of the system, redundant torque motor drivers and feedback elements are used.

B. Fuel Delivery System (Ref. Fig. 006, 007)

(1) Description

(a) Fuel flows from the aircraft fuel tank to the fuel pump boost stage inlet.

(b) Pump boost stage discharge fuel flows to the fuel/oil cooler (IDG and Engine) for the purpose of fuel anti-icing and engine/IDG oil cooling.

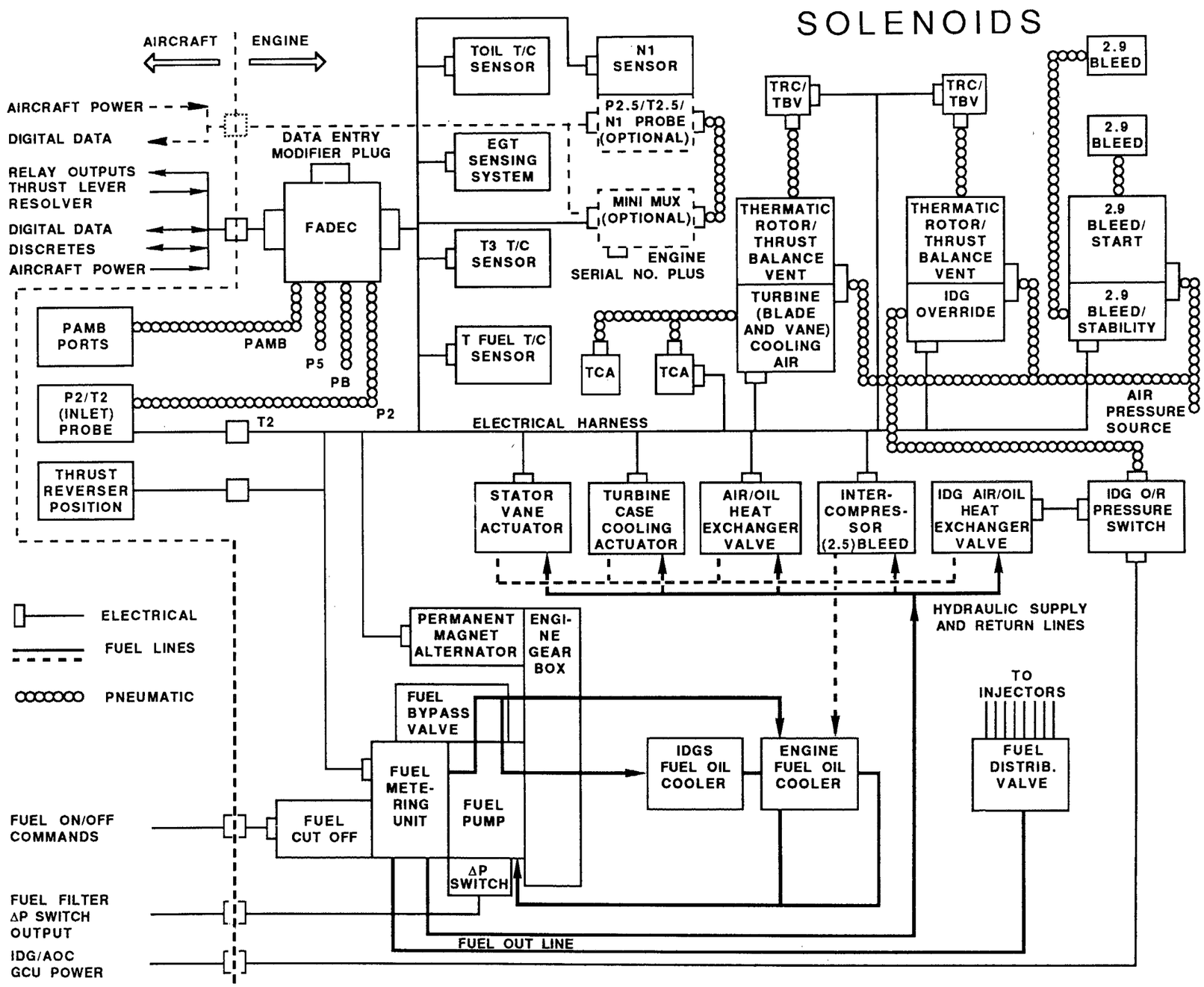
(c) From the fuel/oil cooler the fuel is returned to the fuel pump. It is filtered and sent to the main stage.

(d) The main stage discharge fuel flows to the fuel metering unit through a fine line filter.

(e) From the fuel metering unit, servo fuel (Pf) flows to interface components, metered fuel flows through the fuel flow transmitter to the fuel distribution valve and bypass fuel is returned to pump interstage flow.

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Engine Control System Functional Block Diagram
Figure 005

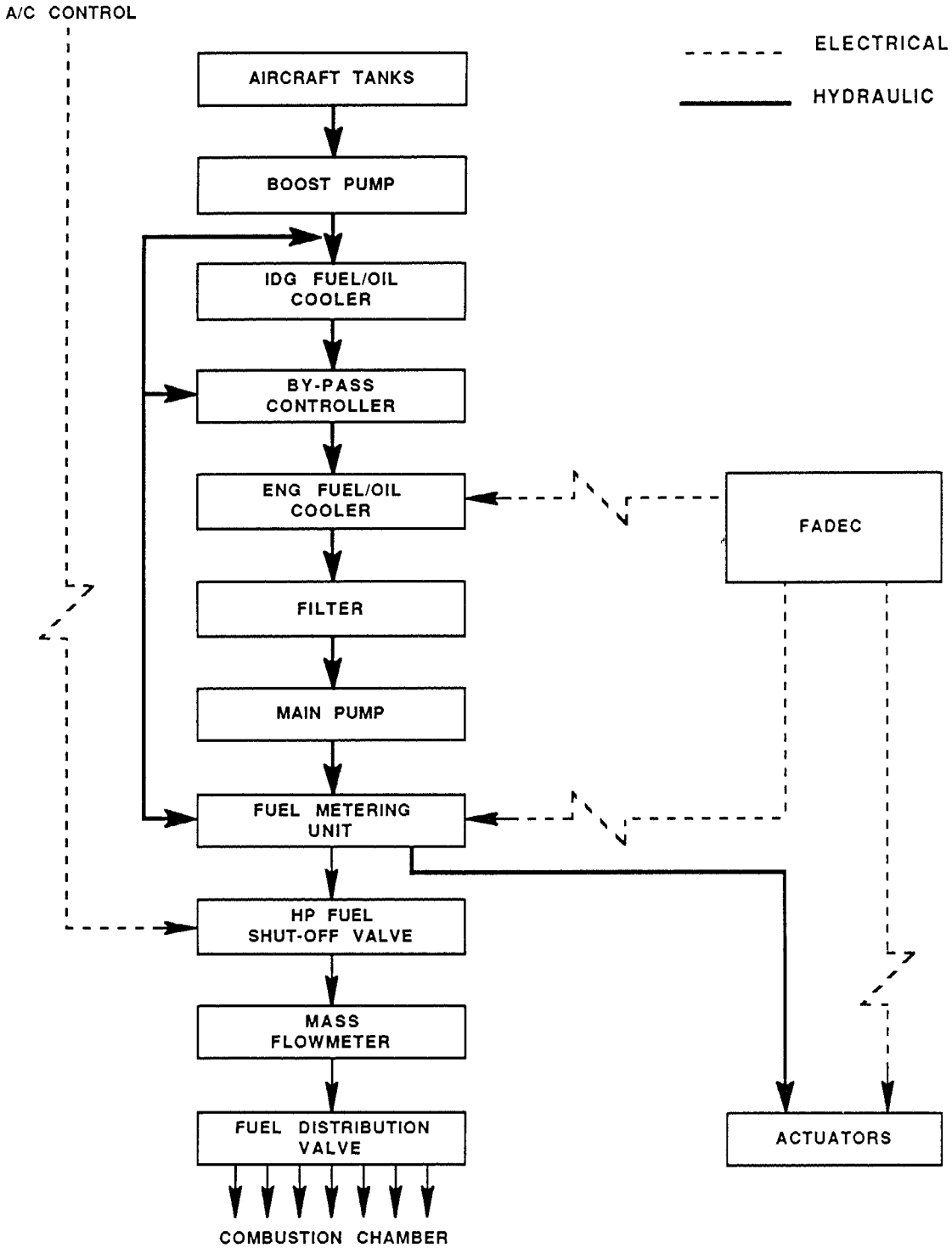
The fuel metering unit contains a torque motor which responds to commands from the FADEC to position the metering valve. Metered fuel from the fuel metering unit is delivered to the fuel distribution valve, which divides the fuel equally among eight manifolds, each of which feed three single-orifice fuel injectors.
Fuel shutoff and pressurization are accomplised with an electrical signal from the cockpit center pedestal to the fuel shut off valve actuator installed on the fuel metering unit, (independent of the FADEC).

3. Component Location
For location of the different controls and indications used for the engine fuel and control systems (Ref. Fig. 008).
For location of circuit breakers (Ref. Fig. 009, 010)

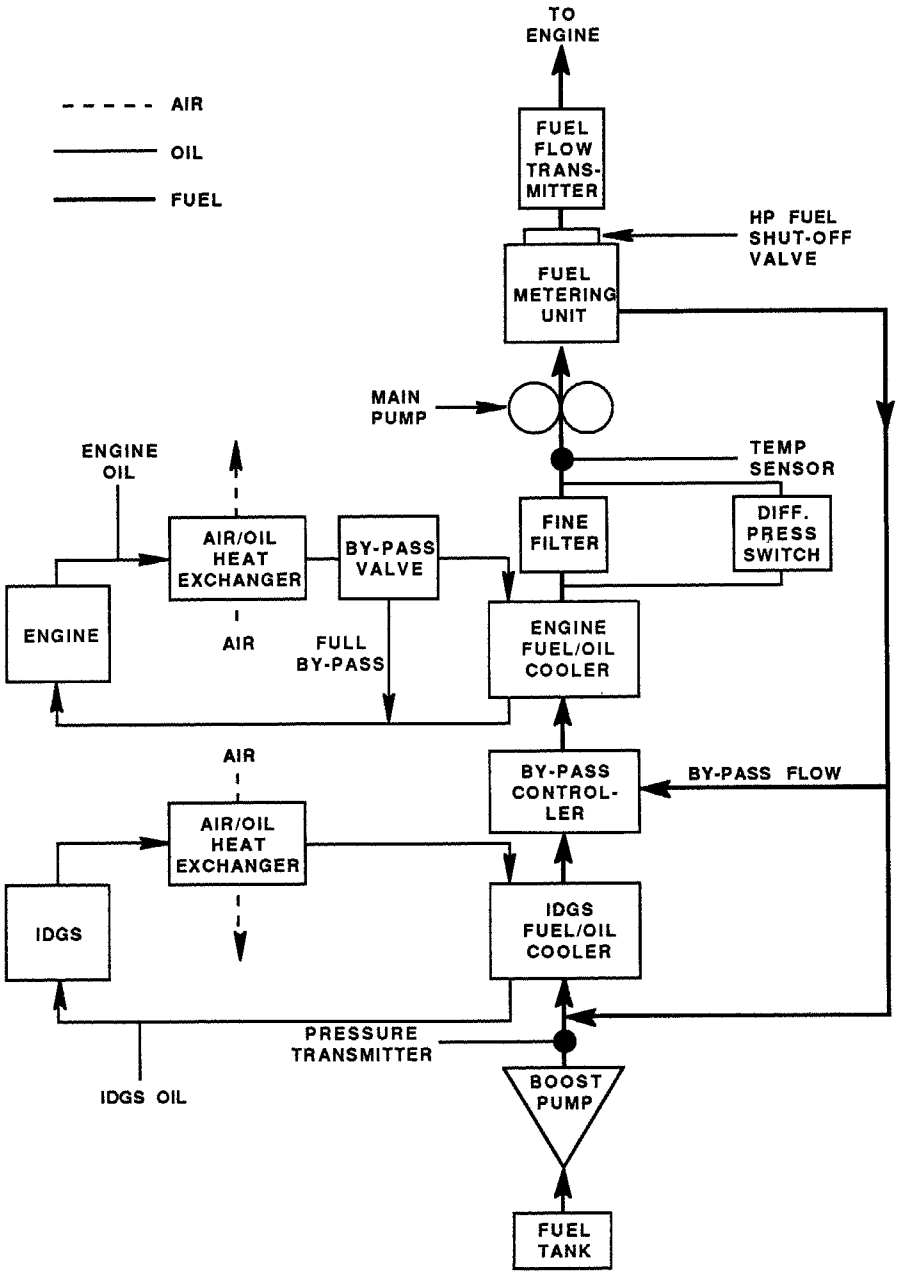
4. Monitoring
The engine fuel and control system is monitored from :
- the center instrument panel,
- the ECAM display,
- local warning lights,
- MASTER WARN and MASTER CAUTION lights.

Indications and warnings cover :
- FADEC system health or status information requiring a crew action,
- Fuel pressure,
- Flow rate,
- Fuel used,
- Filter condition.

5. Electrical Supply (Ref. Fig. 011)
The aircraft electrical supply to the engine fuel and control system is shown on referenced figure.



Engine Fuel Control - Schematic
Figure 006

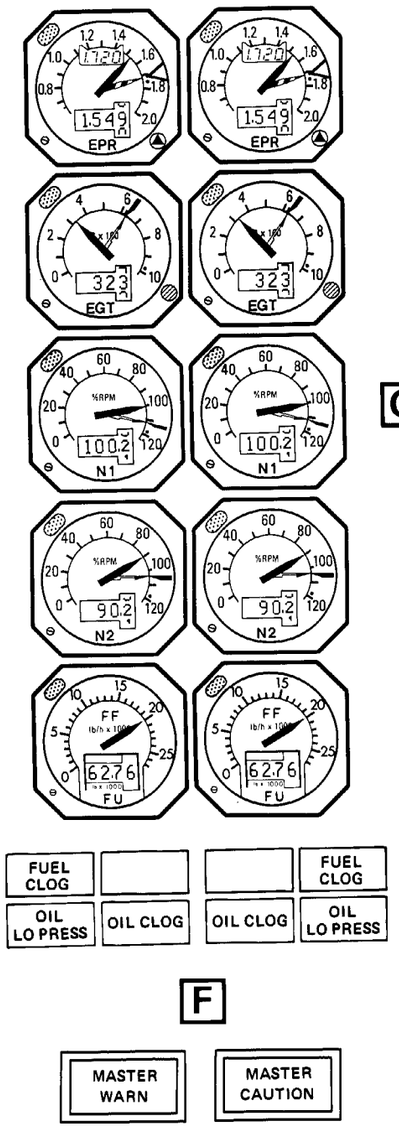


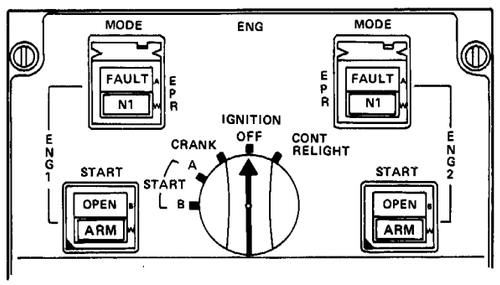
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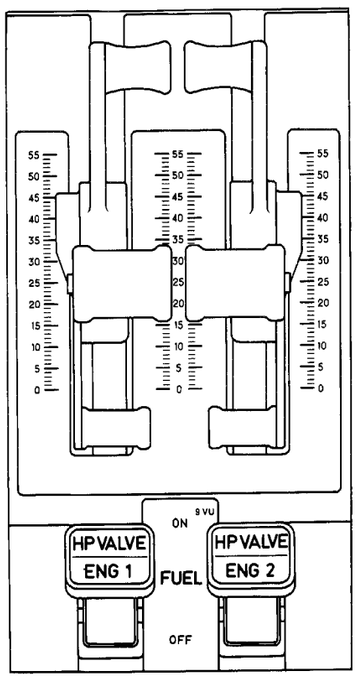
Engine Fuel System
Figure 007

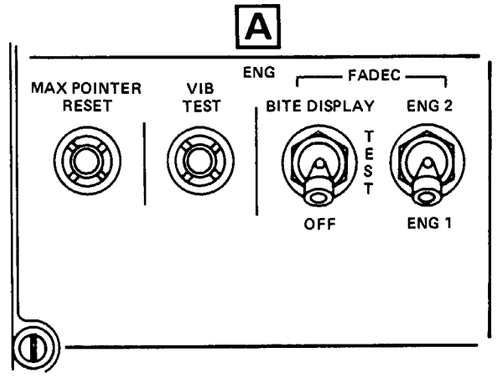
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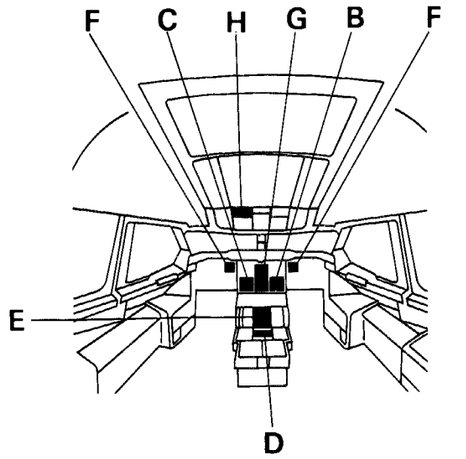
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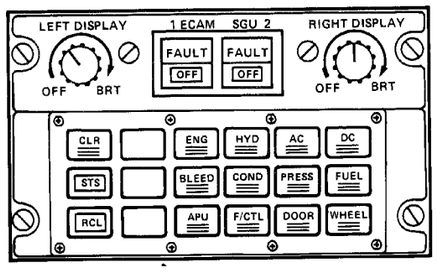


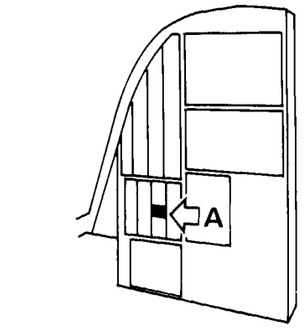


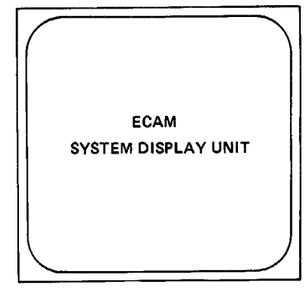


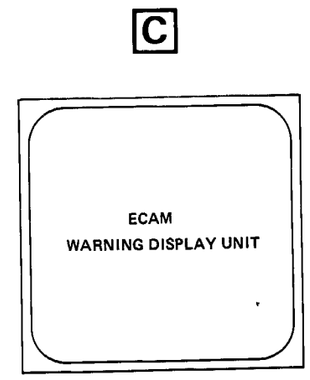






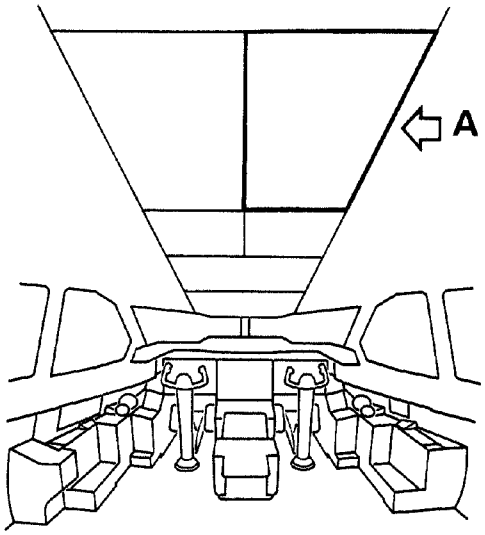


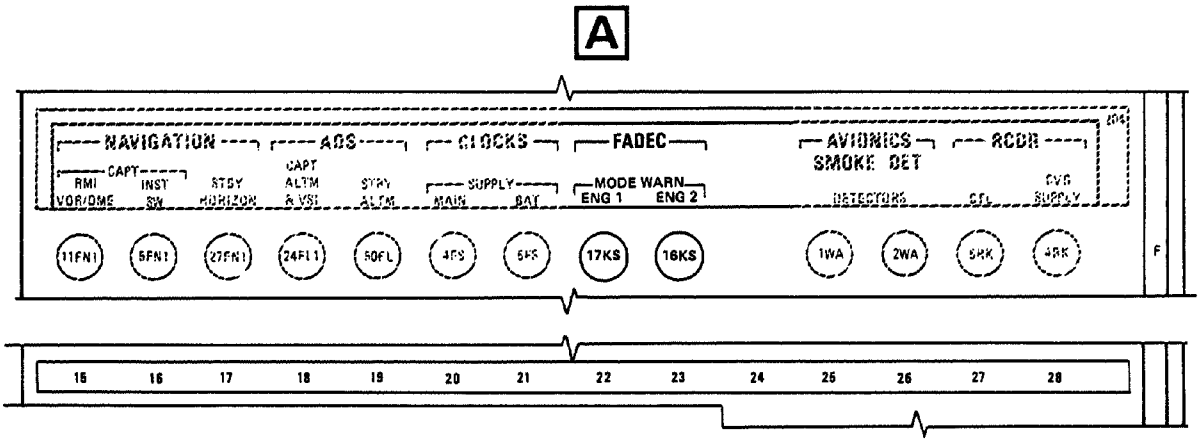




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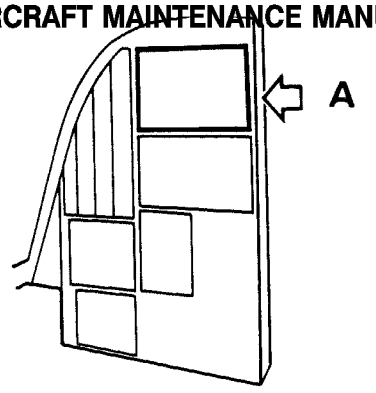
Control and Indicating - Component Location
Figure 008

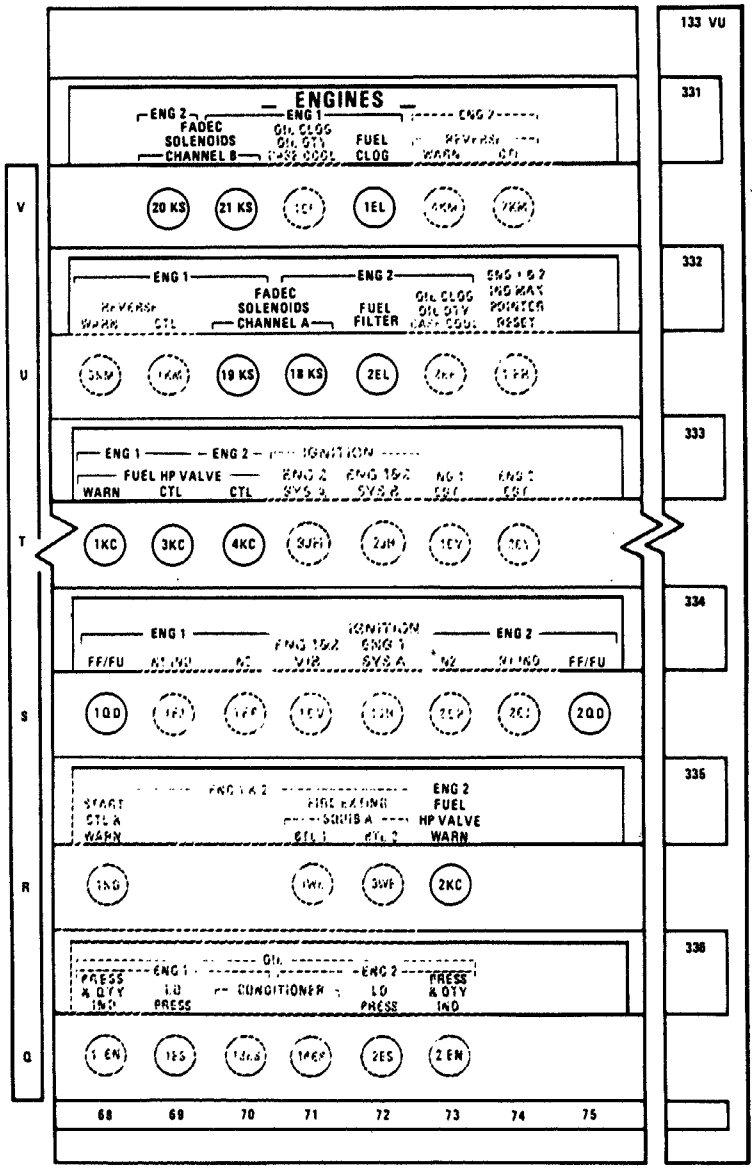




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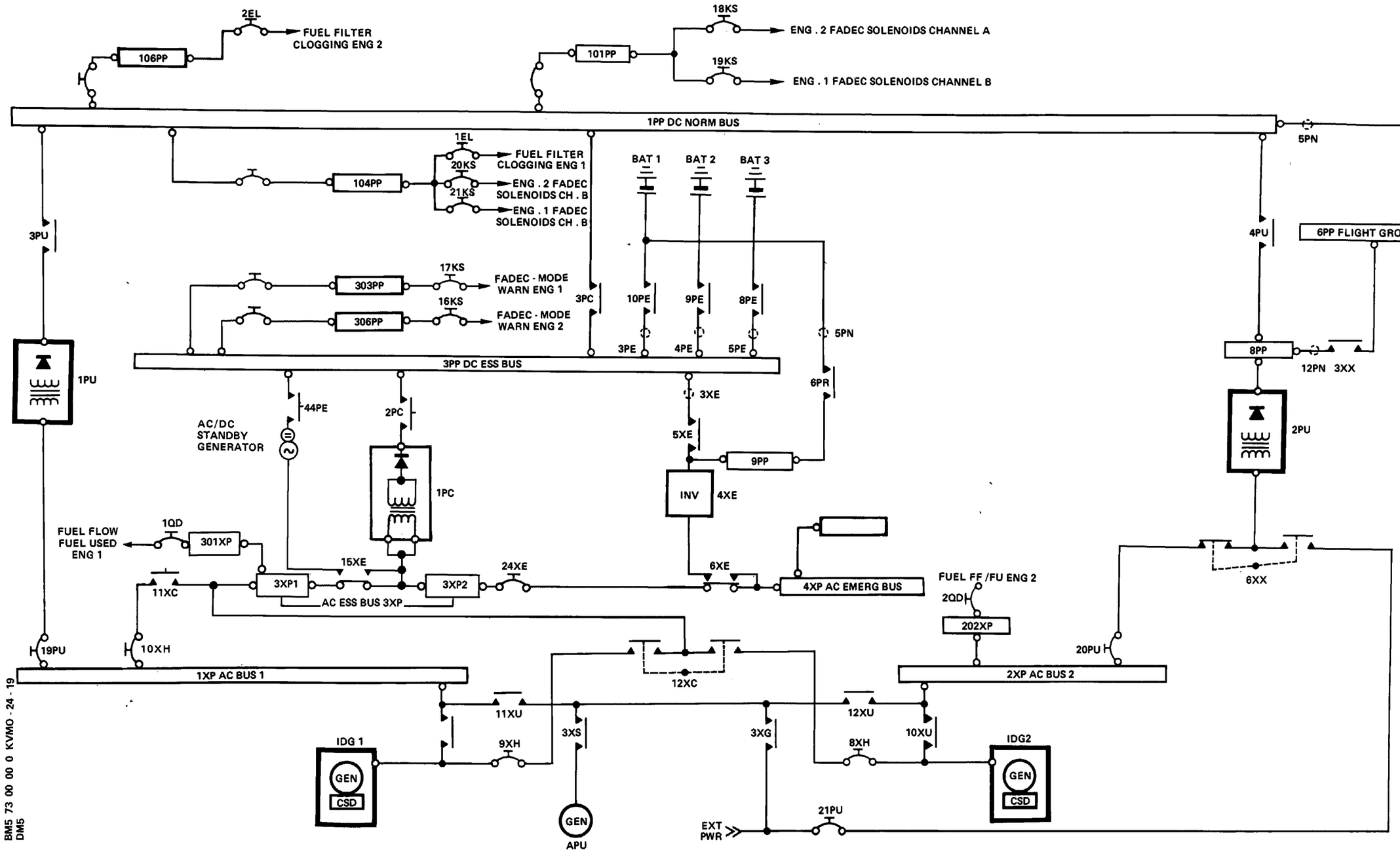
Circuit Breakers - Component Location
Figure 009





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DM5

Circuit Breakers - Component Location
Figure 010



Fuel System - Electrical Supply
Figure 011

1. Inspect Engine Fuel and Control System

A. Procedure

(1) Inspection Reference Table is intended to serve as an aid for identifying certain areas and conditions whenever disassembly time permits inspection. Disassembly inspection should not be accomplished solely on basis of these tables. Tables should be used when disassembly is required as a result of other maintenance actions.

(2) Table 601 does not imply that items or conditions listed are all-inclusive. Experience and judgment will continue to be an important part of any inspection program.

ITEM	INSPECT FOR	CHAPTER/SECTION REFERENCE
Fuel Pump	External Leakage. Security of mounting.	73-12-01
Fuel Pump Filter	Contamination of paper (cartridge) filter element. Look for bronze colored particles. If you find bronze contamination, you must replace the fuel metering unit and the fuel pump. NOTE : Pump filter element must be checked frequently in new aircraft and after rework of fuel tanks.	73-12-03
Fuel Distribution Valve	External fuel leakage. Security of mounting.	73-13-04
Fuel Distribution Valve Strainer	Inlet screen contamination and damage.	73-13-05
Fuel Metering Unit	External fuel leakage. Security of fuel metering unit to pump. Security of electrical	73-23-00

ITEM	INSPECT FOR	CHAPTER/SECTION REFERENCE
	connectors.	
FADEC Inlet Pressure Temperature (PT2/TT2) Probe	Security of electrical connector.	73-24-07
	Security of mounting.	

2. Leak Check Fuel Distribution System

A. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B. Material No.P03-001	Oils (Ref. 70-00-00)
C. Material No.P05-007	Special Materials (Ref. 70-00-00)
D. Material No.P06-002	Lubricants (Ref. 70-00-00)
E. PWA85579	Adapter
F.	Packings
G.	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
H. PWA86459	Puller, Strainer
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 73-13-05, P. Block 601	Fuel Distribution Valve Strainer
- 73-13-05, P. Block 701	Fuel Distribution Valve Strainer

B. Job Set-Up

(1)Open, safety and tag the appropriate circuit breakers, and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

C. Inspection (Ref. Fig. 601)

NOTE : Minimum clearance between any two adjacent tubes or between one single tube and any other adjacent engine part shall be 0.125 in. (3.175 mm) unless otherwise specified. Exceptions to this clearance requirement are permitted at specific locations where adjacent tubes are clipped together or where other local constraints will prevent tube contact at clearances below 0.125 in. (3.175 mm) minimum. Minimum clearance refers only to clearance relative to tube and not to fittings or other attached hardware.

(1)Disconnect W5P8 harness connector from fuel temperature probe on fuel pump filter housing. Install protective closures.

(2)Remove bolts securing front and rear flanges of fuel flowmeter support

tube to fuel flowmeter and to fuel distribution valve. Remove fuel flowmeter support tube and bracket from engine.

(3) Be prepared to receive approximately one quart (one liter) of fuel from transfer tube connection.

(4) Translate packing transfer tube assembly rearward into distribution valve cover.

(5) Remove bolts and washers securing strainer housing cover to distribution valve. Remove cover and tube from valve. Remove tube from cover. Discard packings from tube and cover.

CAUTION : USE THE PWA 86459 PULLER TO AVOID DAMAGE TO THE STRAINER.

(6) Engage the PWA 86459 Puller to the strainer and pull the strainer from the housing. Disengage the puller from the strainer and remove the puller and the strainer from the engine separately.

(7) Inspect fuel distribution valve strainer (Ref. 73-13-05, P. Block 601).

(8) Clean fuel distribution valve strainer (Ref. 73-13-05, P. Block 701).

(9) Install packing lubricated with Material No.P06-002, to groove in end of strainer and install strainer into fuel distribution valve housing.

(10) Install PWA 85579 Adapter to four-hole pad on valve aligning offset bolthole and secure with detail bolts

(11) Using available air supply through above adapter pressurize fuel manifold and distribution valve to 95 - 105 psig (6.55 - 7.24 bars) with air and check for leaks by applying Material No.P05-007, for five (5) minutes. There shall be no visible leakage from any surface, joint or connection.

(12) If any leakage is present, replace and/or repair as required and repeat step (11) as required.

(13) If for any reason any portion of subject system has been removed or replaced at assembly, repeat step (11) as required.

(14) Disconnect air supply and remove adapter from fuel distribution valve. Store bolts in threaded holes in adapter.

(15) Install two packings lubricated with Material No.P06-002, to grooves in packing transfer tube assembly. Install transfer tube into distribution valve cover.

(16) Install packing lubricated with Material No.P06-002, to cover and install cover (with tube) to fuel distribution valve housing aligning offset bolthole. Secure strainer cover with washers and bolts threads lubricated with Material No.P03-001. TORQUE bolts to between 30 and 33 lbf.in. (0.34 and 0.37 m.daN).

(17) Translate transfer tube forward with dowel pin and boltholes aligned.

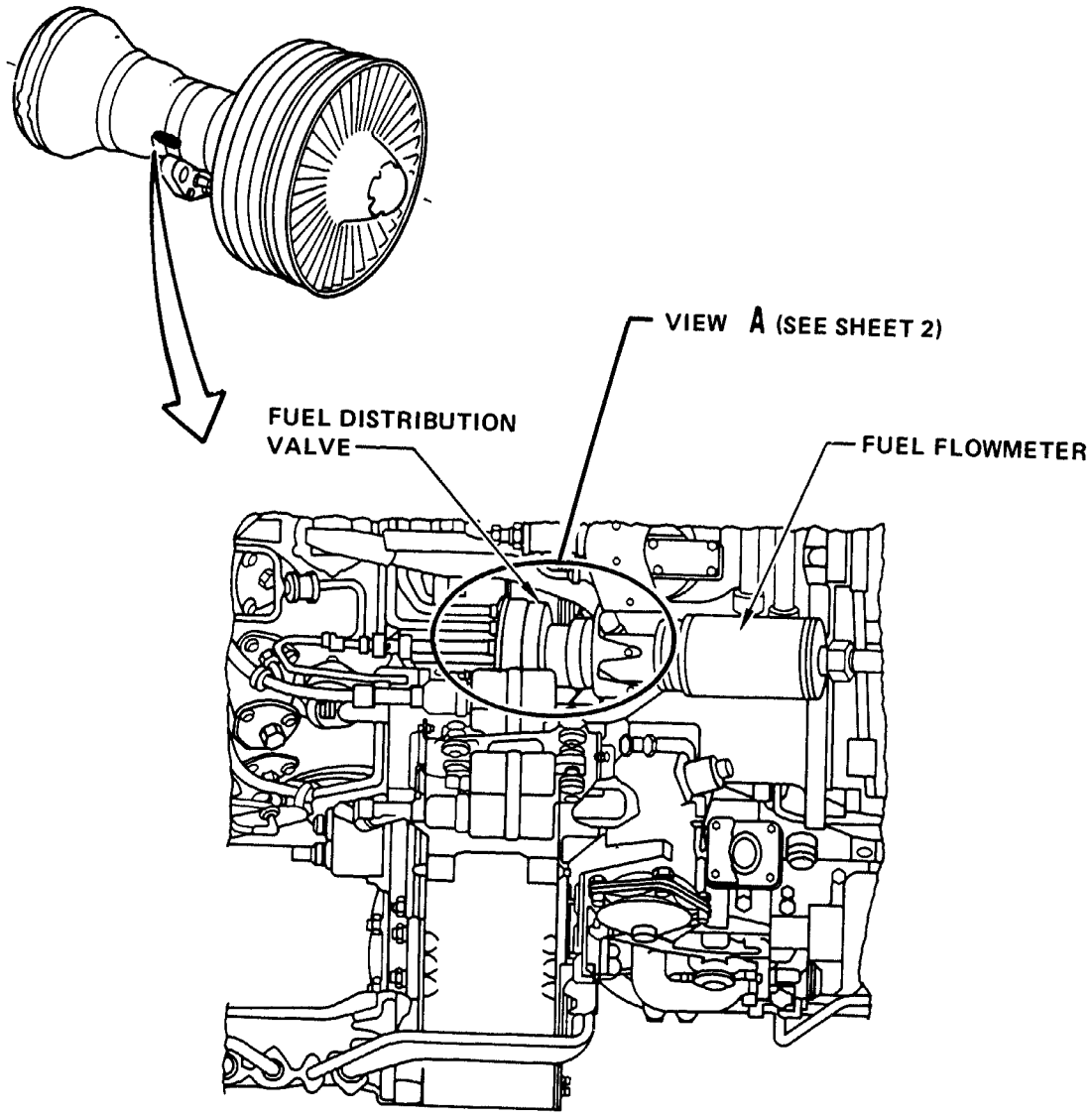
NOTE : Make certain sealplate is installed against rear flange of fuel flow meter and dowel pin is aligned.

(18) Install fuel flowmeter support over transfer tube aligning dowel pin on transfer tube with slot in support and aligning boltholes in rear flange. Install bracket over support and position.
(Ref. Fig. 601)

(19) Secure rear flange with bolts, (without drilled heads) threads lubricated with Material No.P03-001. Secure front flange with drilled head bolts, threads lubricated with Material No.P03-001.

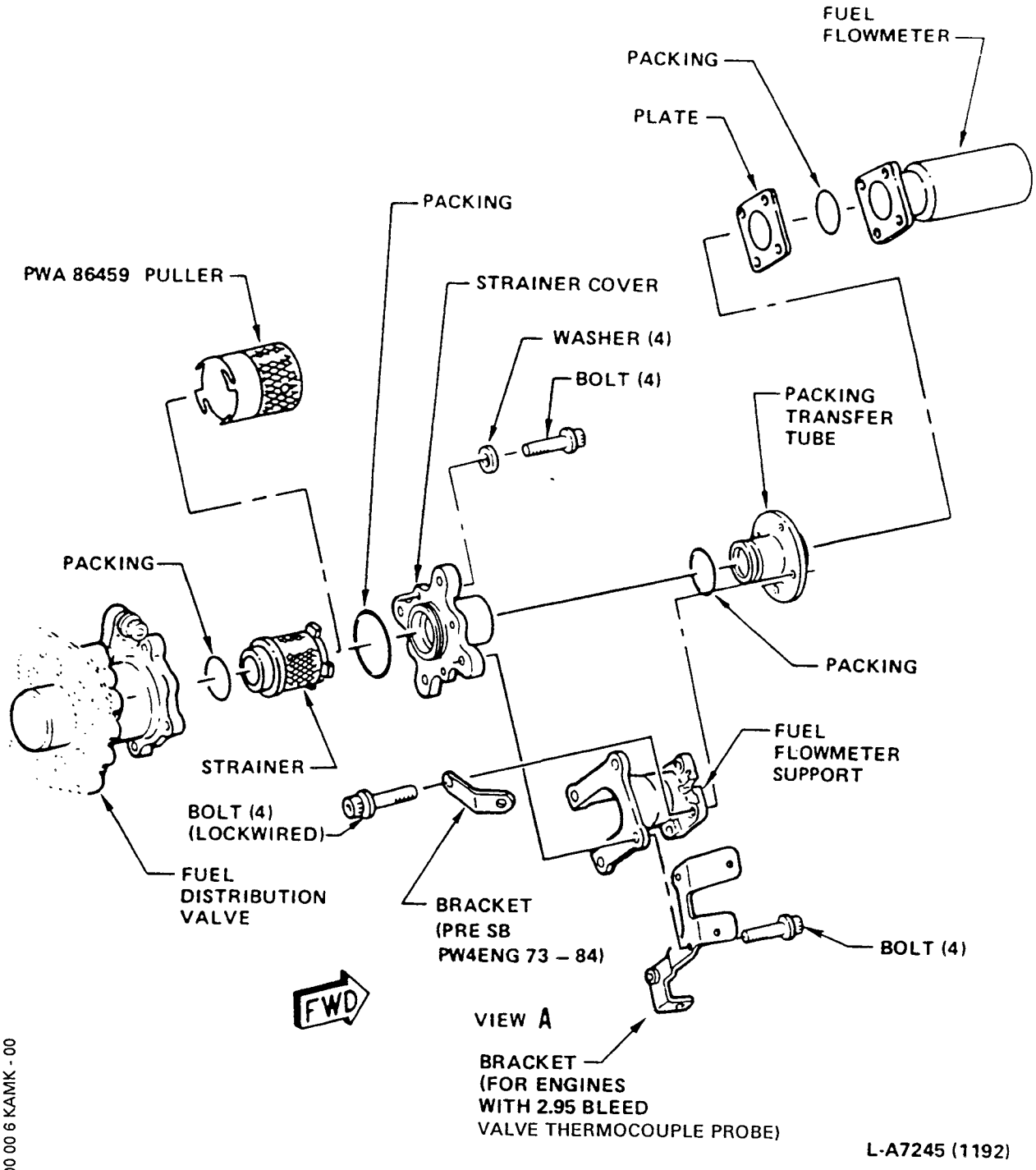
(20) TORQUE all bolts at front and rear flanges to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN). Wirelock bolts on front flange.

(21) Remove protective closures. Connect W5P8 harness connector to fuel temperature probe on fuel pump filter housing as follows :

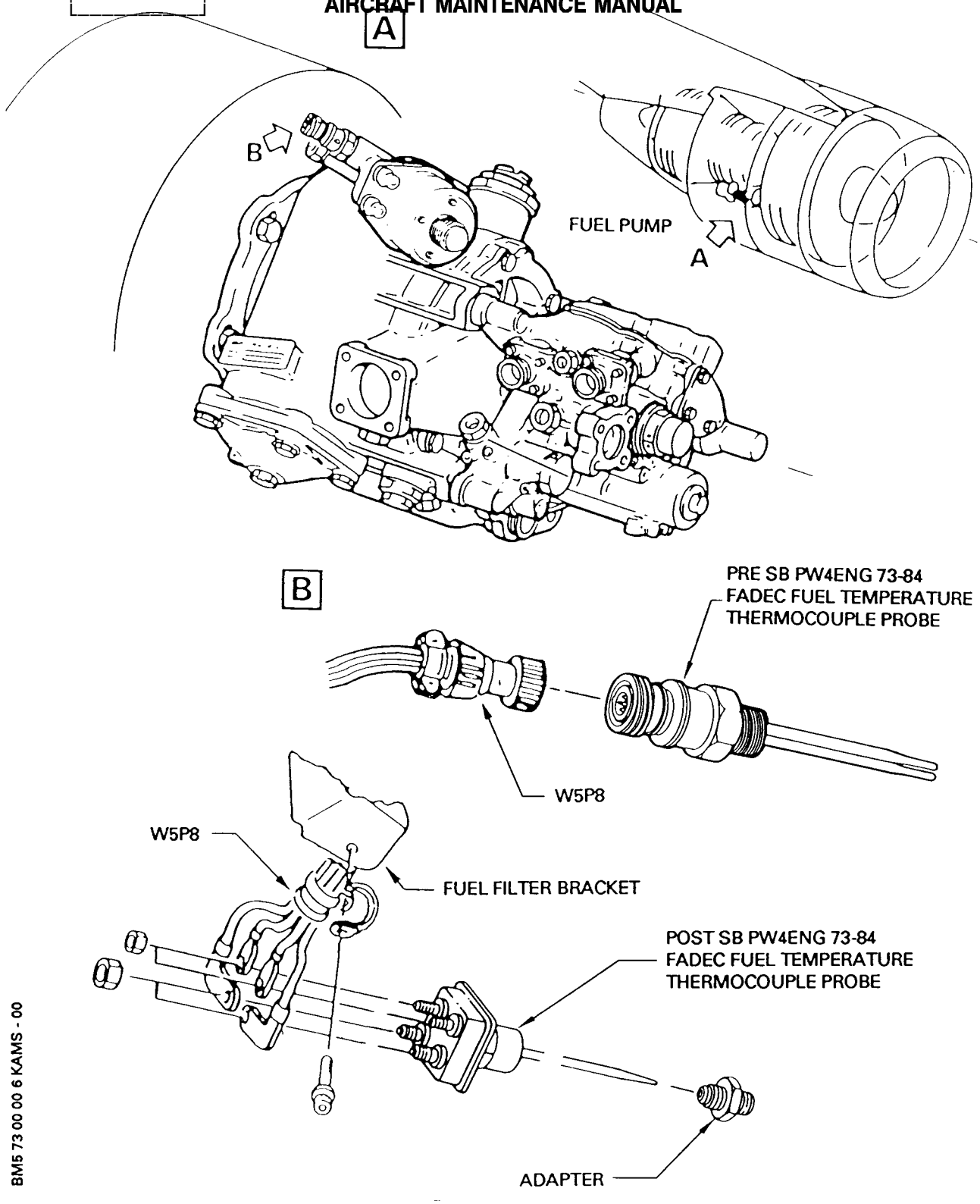


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Fuel Distribution Valve Inlet Connection (Sheet 1/3)
Figure 601



Fuel Distribution Valve Inlet Connection (Sheet 2/3)
Figure 601



Fuel Distribution Valve Inlet Connection (Sheet 3/3)
Figure 601

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(a)(Pre SB PW4ENG 73-84) align connector keyway and push harness connector into mating receptacle.
While pushing inward on connector, tighten coupling ring handtight. Connector is properly secured when closest to threads color band around receptacle is fully covered by coupling ring.

(b)(Post SB PW4ENG 73-84) Remove the nuts from the thermocouple terminal studs and secure with nuts (round collar end inboard). Align the leads so that they are parallel to one another.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS

1 Torque the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.21 and 0.24 m.daN).

2 TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

D. Close-Up and Test

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301). Remove safety clips and tags and close circuit breakers.

(3)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

3. Specific Fits and Clearances

A. General

(1)Reference numbers on figures indicate location of parts for which fits and clearances are specified.
Description of, and limits for, these fits and clearances are located in tables of corresponding reference numbers.

(2)Unless otherwise specified, all fits are diametral.

(3)Numbers in all columns shall be interpreted in inches, and (millimeters).

(4)Letter "T" following limits indicates tight fit.

(5)Description column provides nomenclature for part or parts concerned.

B. Inspection Frequency Requirements

(1)IFR column provides Inspection Frequency Requirements.
Letter Codes A, B or C located in IFR column indicate manner and frequency of inspection recommended for item identified by adjacent reference number, as applicable to normal or routine repair. Definitions for these codes are as follows :

IFR CODE	Definition
A	Clearance or fit must be calculated from part measurements at each installation of parts. Part measurements taken and re-

IFR CODE	Definition
	corded at time of individual part inspection are considered equally as valid as measurements taken at time of part installation.
B	Clearance or fit must be estimated at each installation of parts. Use trial assembly or similar means to estimate clearance or fit. Measurement of parts and calculation of actual fit or clearance is required only if : Estimating procedure indicates that clearance or fit is outside specified tolerance, or Either or both mating parts involved have been replaced or repaired in an area or way which would affect the clearance or fit.
C	Fit not subject to change in normal engine operation. Measurement of parts and calculation of fit is required only if either of mating parts involved has been replaced or repaired in an area or way which would affect fit.

C. New Part Reference Dimensions
(1)Dimensions are provided in this column for reference only.
(2)Dimensions are the Minimum and Maximum manufacturing values in inches (and millimeters) for each part listed in the description column.

D. Limits
(1)Limits applicable to any combination of new or used parts.
(a)This column provides the acceptable (minimum - maximum) range of fit or clearance in inches (and millimeters). These limits may be applied to any combination of new or used parts.
(b)The limits are based on the mathematical combination of the minimum and maximum values specified in the New Part Reference Dimensions column. See Example 1.
(c)Limits which have been expanded to be less restrictive than new part conditions are identified with an asterisk (*) adjacent to the value. See Example 2.

EXAMPLE 1 :

Ref No.	IFR	Description	New Part Reference Dimensions Min	Max	Limits Min	Max
1812		Bearing ---------	0.508 (12.903)	0.512 (13.005)		
		Support ---------	0.517 (13.131)	0.527 (13.385)	0.005 (0.126)	0.019 (0.482)

Ref No.	IFR	Description	EXAMPLE 1 : New Part Reference Dimensions Min - Max	Limits Min - Max

NOTE : In Example 1 limits are determined by comparing bearing and support referenced dimensions as follows :

R 0.517 in.(13.131 mm) - 0.512 in.(13.005 mm) = 0.005 in.(0.126 mm)
R 0.527 in.(13.385 mm) - 0.508 in.(12.903 mm) = 0.019 in.(0.482 mm)

Ref No.	IFR	Description	EXAMPLE 2 : New Part Reference Dimensions Min - Max	Limits Min - Max
1812		Bearing ---------	0.508 (12.903) - 0.512 (13.005)	
		Support ---------	0.517 (13.131) - 0.527 (13.385)	0.005 (0.126) - 0.020* (0.508)*

NOTE : In Example 2 limits represent less restrictive values as indicated by the asterisk (*).

(2)Limits for selective application to engines scheduled for partial refurbishment.
(a)A second set of limits enclosed by brackets and lines may be provided, See Example 3. These enclosed limits are less restrictive and are intended to be selectively applied to engines scheduled for partial refurbishment.

Ref No.	IFR	Description	EXAMPLE 3 : New Part Reference Dimensions Min - Max	Limits Min - Max
1812		Bearing ---------	0.508 (12.903) - 0.512 (13.005)	
		Support ---------	0.517 (13.131) - 0.527 (13.385)	0.005 (0.126) - 0.019 (0.482)
				.005 (0.13) - .022 (0.56)

NOTE : In Example 3 the enclosed (less restrictive) limits are intended for selective application, see text.

E. Fits and Clearances (Ref. Fig. 604, 608, 609)

Ref No.	IFR	Description	New Part Reference Dimensions Min	New Part Reference Dimensions Max	Limits Min	Limits Max
295	B	Fuel Injector Support Diffuser Case Assembly				
		Support ---------	1.821 (46.254)	1.823 (46.304)		
		Case ------------	1.824 (46.330)	1.826 (46.380)	.001 (0.026)	.005 (0.127)
541 (1)	B	Gearbox (FADEC Alternator Drive) Spur Gearshaft FADEC Generator Rotor				
		Gearshaft -------	.7877 (20.0076)	.7880 (20.0152)		
		Rotor ----------- (Pre SB PW4ENG 72-375)	.7882 (20.0203)	.7886 (20.0304)	.0002 (0.0051)	.0009 (0.0228)
541 (2)	B	Gearbox (FADEC Alternator Drive) Spur Gearshaft FADEC Generator Rotor				
		Gearshaft -------	.7877 (20.0076)	.7880 (20.0152)		
		Rotor ----------- (Pre SB PW4ENG 72-375)	.7872 (19.9949)	.7877 (20.0075)	.0000 (0.0000)	.0008T (0.0203T)
542	B	FADEC Generator Stator Gearbox Generator (FADEC Alternator Housing Assembly				
		Stator ----------	3.180	3.181		

Ref No.	IFR	Description	New Part Reference Dimensions Min - Max	Limits Min - Max
			(80.772) | (80.797)	
		Housing ---------	3.1815 | 3.1825 (80.811) | (80.835)	.0005 | .0025 (0.013) | (0.063)
543	B	Gearbox (FADEC Alternator Drive) Spur Gearshaft FADEC Generator Rotor		
		Gearshaft ------- (with SB PW4ENG 72-375)	.7837 | .7840 (19.9060) | (19.9136)	
		Rotor ---------- (with SB PW4ENG 72-375)	.7832 | .7837 (19.8933) | (19.9059)	.0000 | .0008T (0.0000) | (0.0203T)
1850	B	Gearbox (FADEC Alternator Drive) Spur Gearshaft FADEC Generator (Alternator) Rotor Lock Assembly		
		Gearshaft -------	.672 | .673 (17.069) | (17.094)	
		Lock ----------	.674 | .675 (17.120) | (17.145)	.001 | .003 (0.026) | (0.076)

F. Special Assembly Procedure

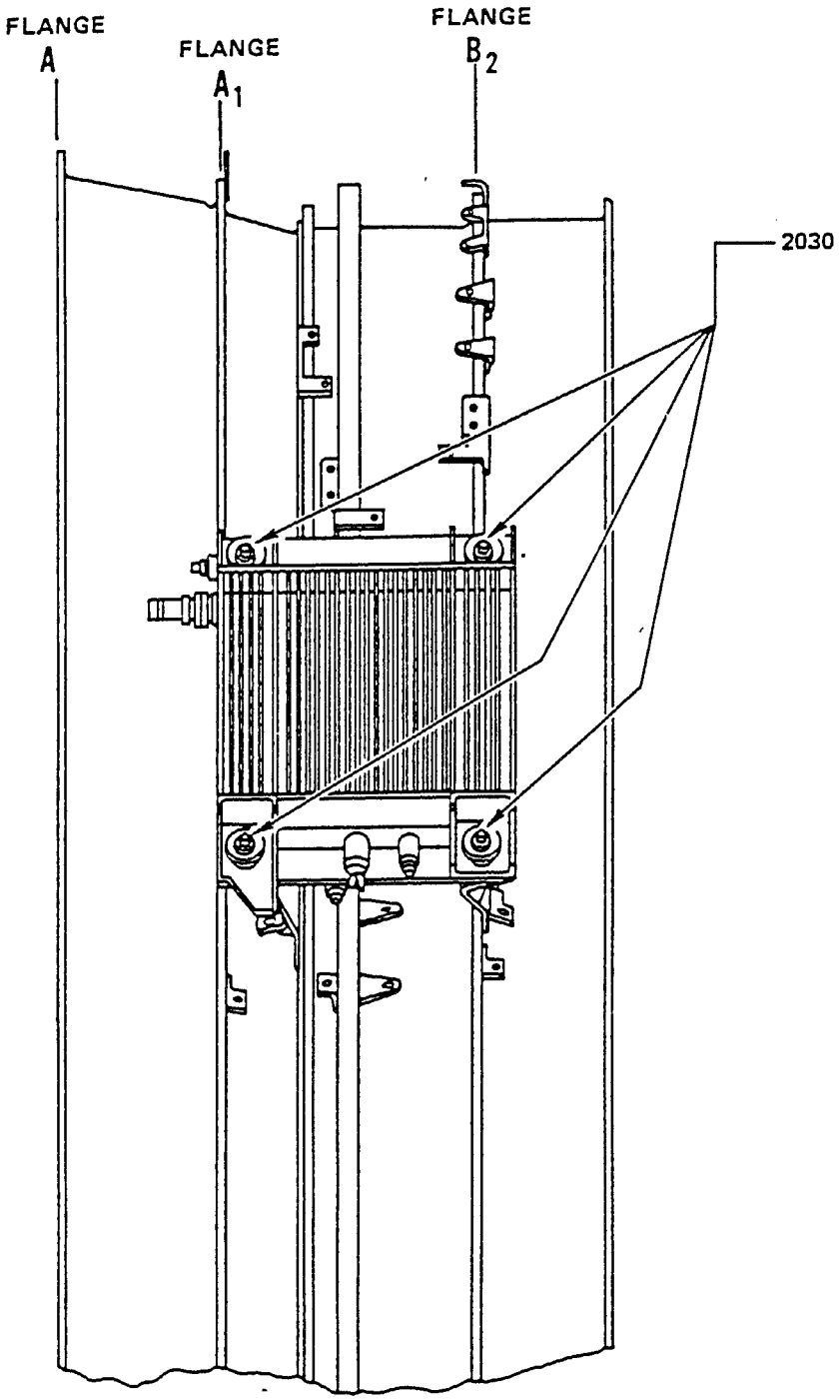
Ref No.	IFR	Description
775	C	Procedure for Measuring Gap between FADEC Speed Transducer (N1) Probe and LPC/LPT Coupling (see NOTE) (Ref. 73-24-09, P. Block 401)

NOTE : (Ref. Fig. 603)

G. Special Torque

Ref No.	I F R	Description
407		A fuel Injector Supply Manifold Assembly Nuts (See NOTE 1) (Ref. 73-13-06, P. Block 401).
410		FADEC Thermocouple Probe (TT3) Locknut (See NOTE 2) (Ref. 13-23-09, P. Block 401).
411		FADEC Thermocouple Probe (TT3) Nut (See NOTE 2) (Ref. 13-23-09, P. Block 401).
570		A FADEC Generator (Alternator) Rotor Lock Retaining Nut (See NOTE 3) (Ref. 73-24-01, P. Block 401).
2030		Full Authority Digital Electronic Engine Control Mounting Bolts (See NOTE 4) (Ref. 73-21-01, P. Block 401).
2152		Fuel Supply Tubes Coupling Nuts (Attach To Fuel Injector Supply Manifold Assemblies) (See NOTE 5) (Ref. 73-13-06, P. Block 401). NOTE : Ref. # 2155 thru # 2160 WIA not be illustrated in this section as Ref. installation procedures provide adequate coverage.
2154		Wiring Harness Connector (Ref. 73-24-08, P. Block 401).
2156		Wiring Harness Connector (Ref. 73-24-08, P. Block 401).

NOTE 1 : (Ref. Fig. 605)
NOTE 2 : (Ref. Fig. 606)
NOTE 3 : (Ref. Fig. 609)
NOTE 4 : (Ref. Fig. 602)
NOTE 5 : (Ref. Fig. 607)

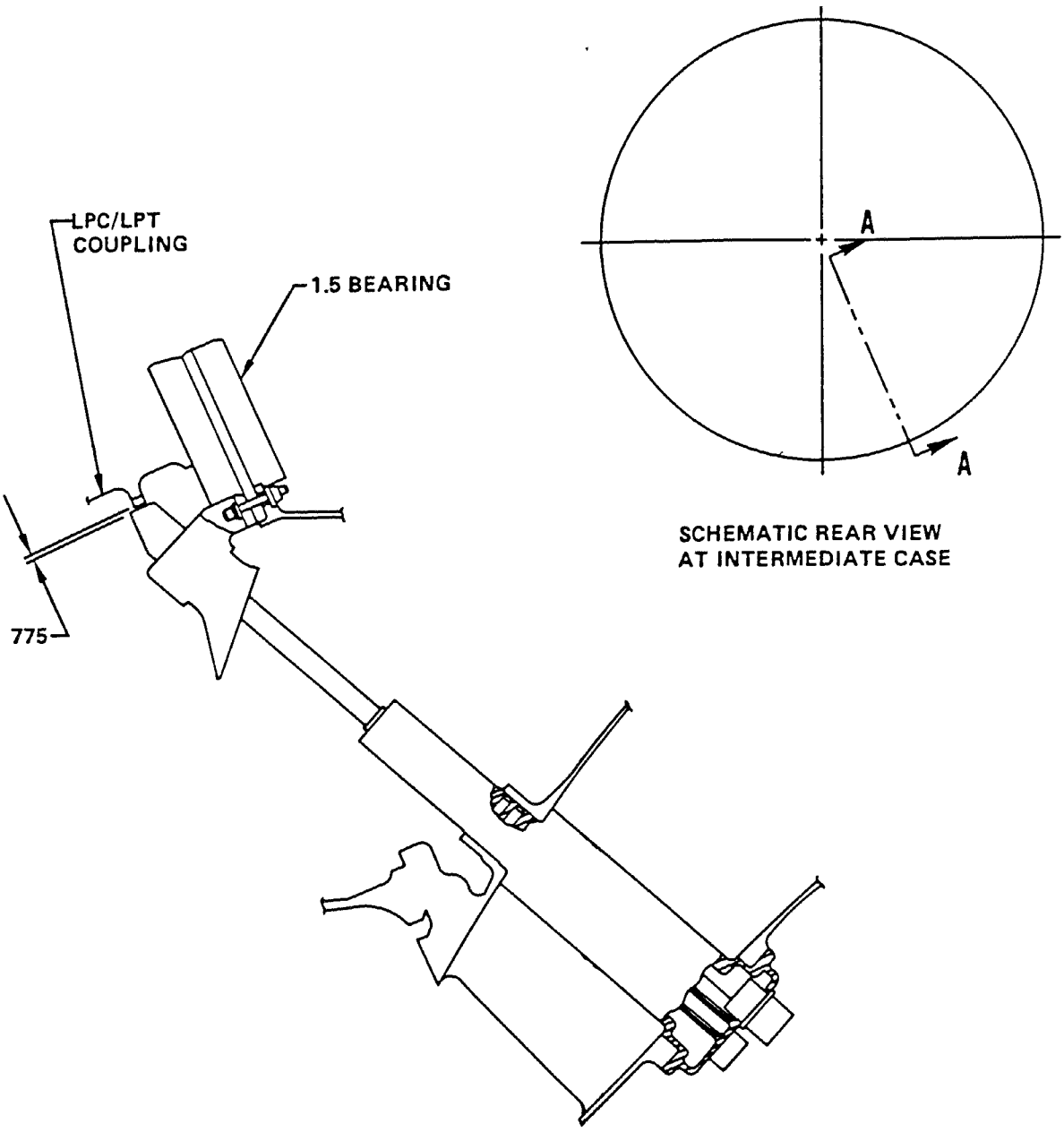


VIEW OF FAN MOUNTED FADEC

L-A2721

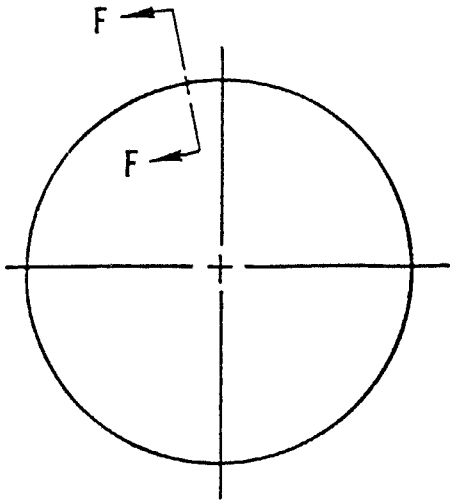
BM5 73 00 00 6 KCMO - 21

FADEC Mounting Bolts
Figure 602

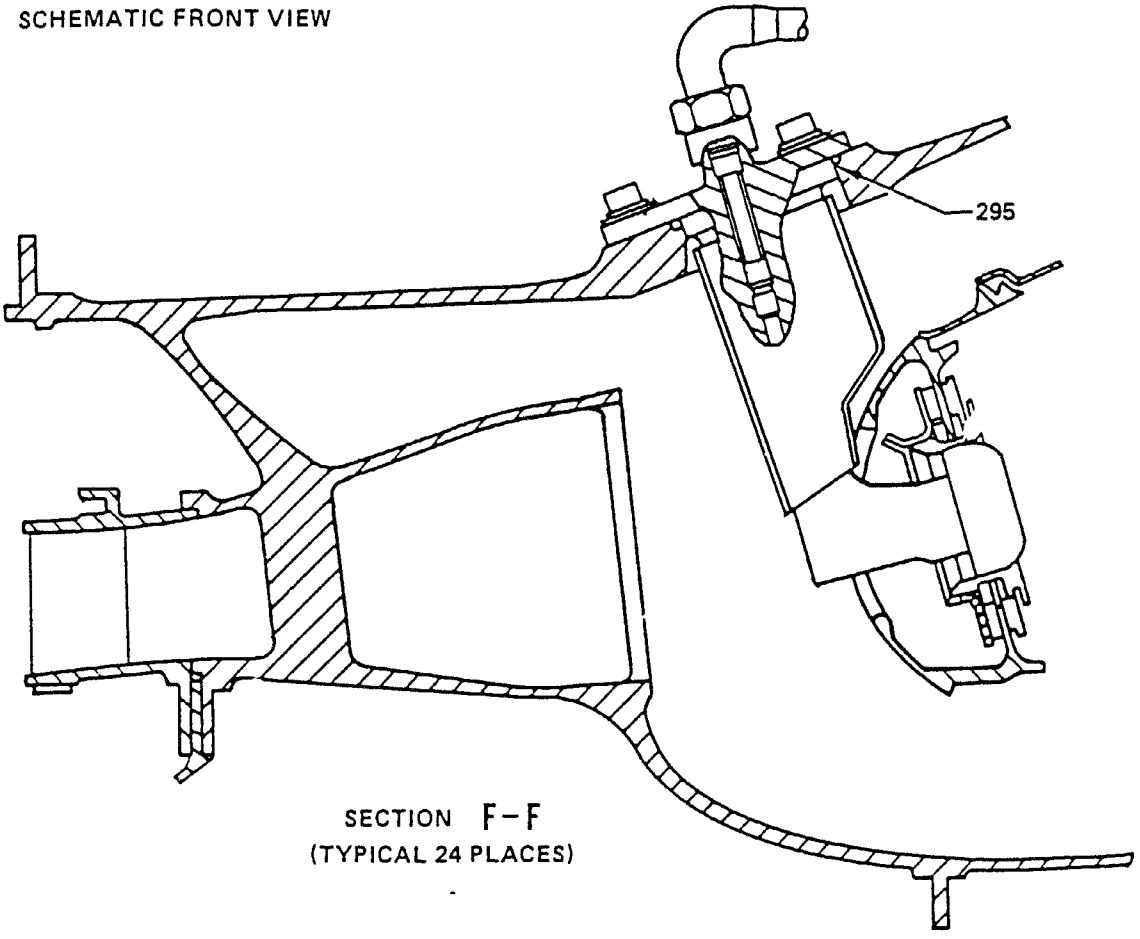


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LPC/LPT Coupling
Figure 603



SCHEMATIC FRONT VIEW

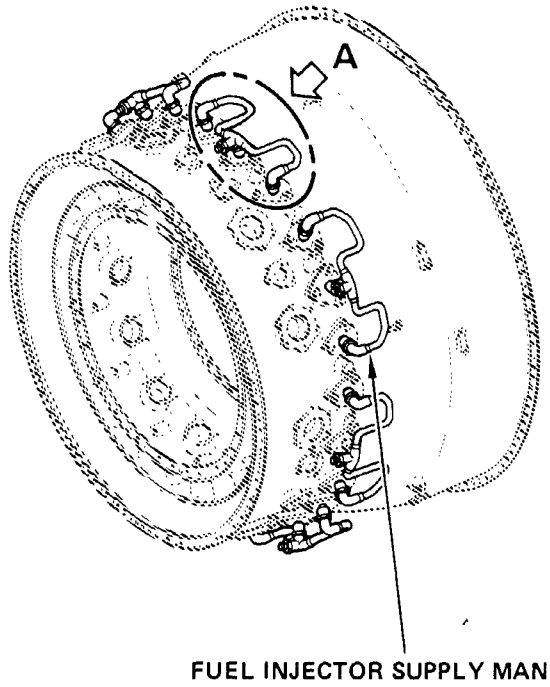


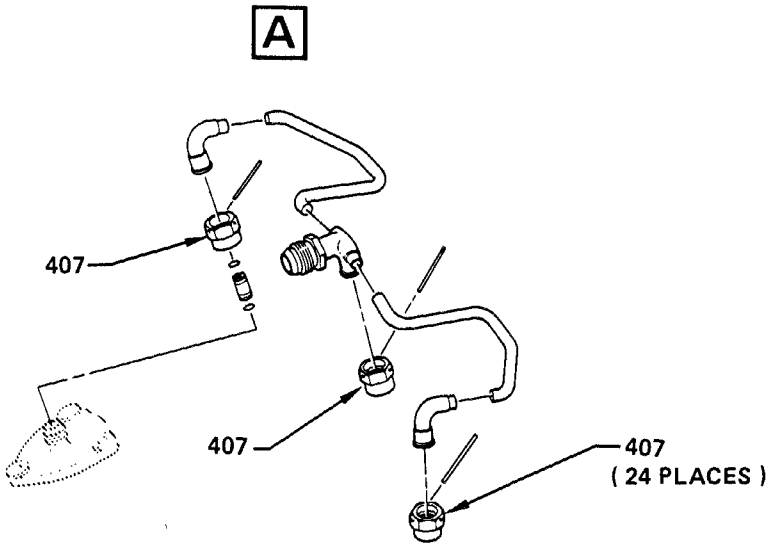
SECTION F-F
(TYPICAL 24 PLACES)

L-A2734

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Diffuser Case Assembly
Figure 604

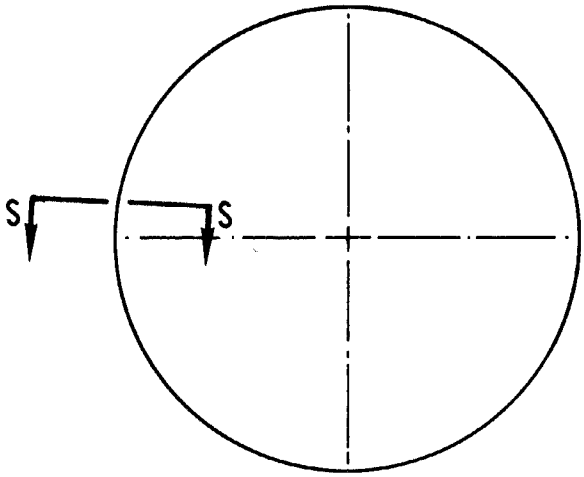




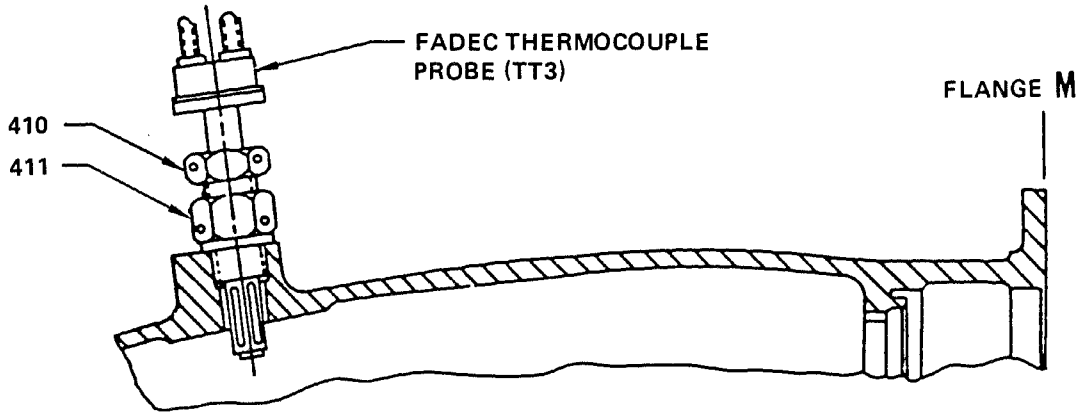
BM5 73 00 00 6 KJMO - 21

L-A0614

Fuel Injector Supply Manifold
Figure 605



SCHEMATIC FRONT VIEW

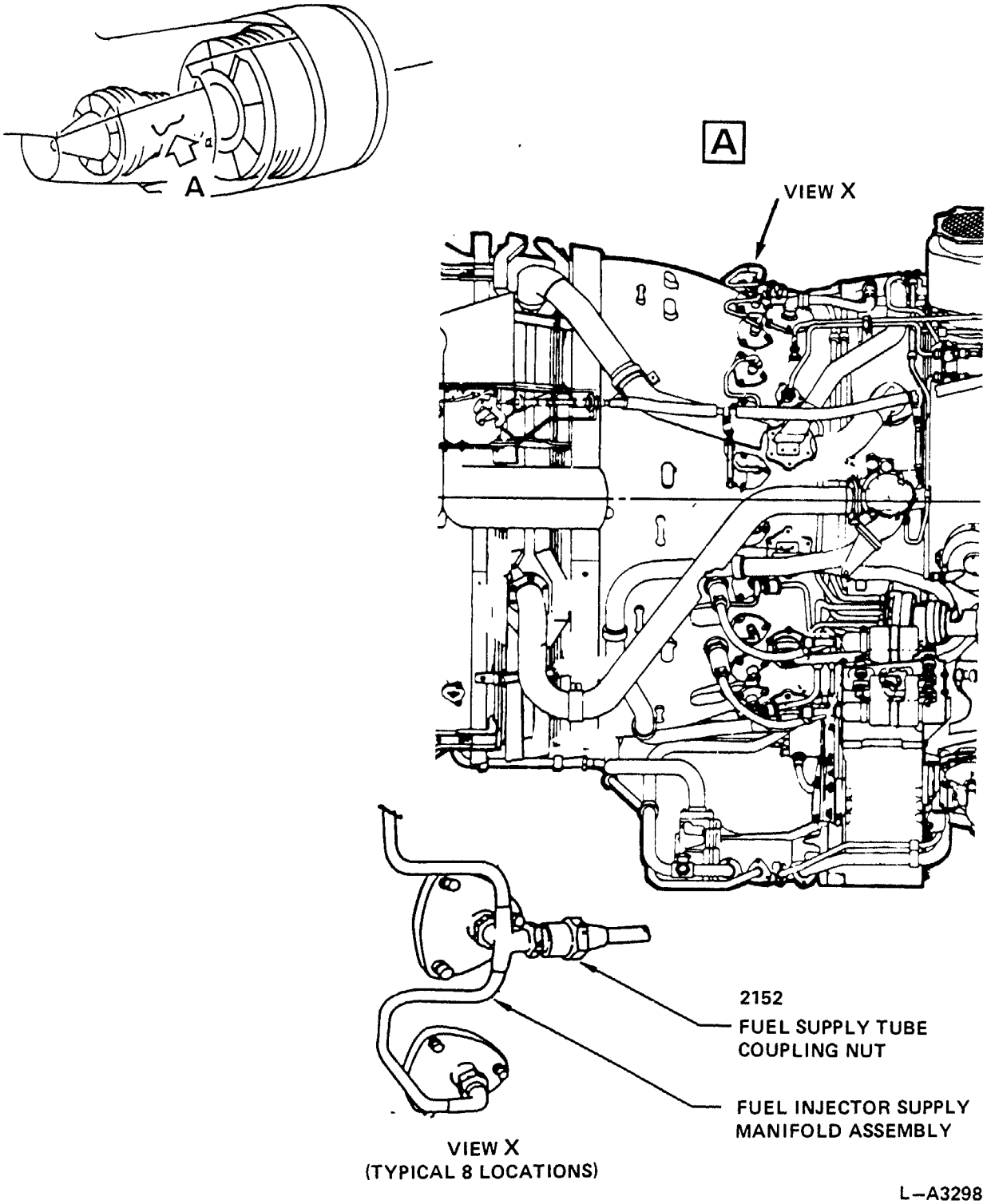


SECTION S-S
(ROTATED 90 DEGREES)

BM5 73 00 00 6 KLMO . 21

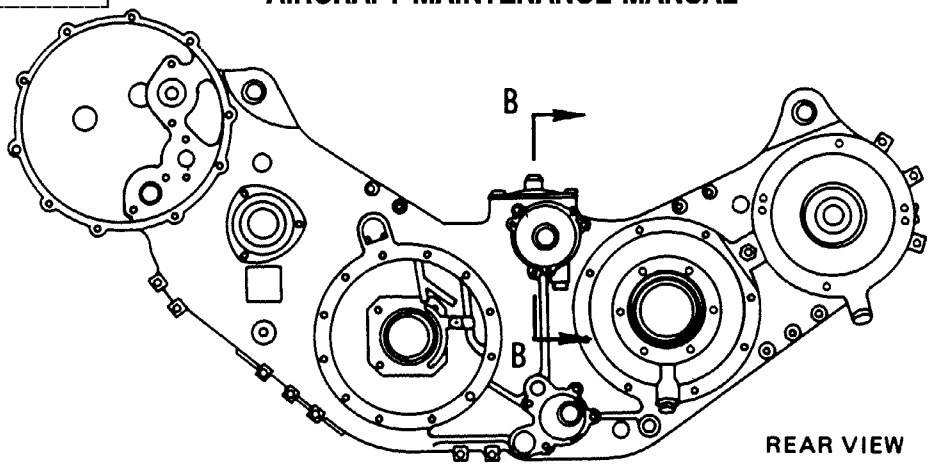
L-A1724

FADEC Thermocouple Probe TT3
Figure 606

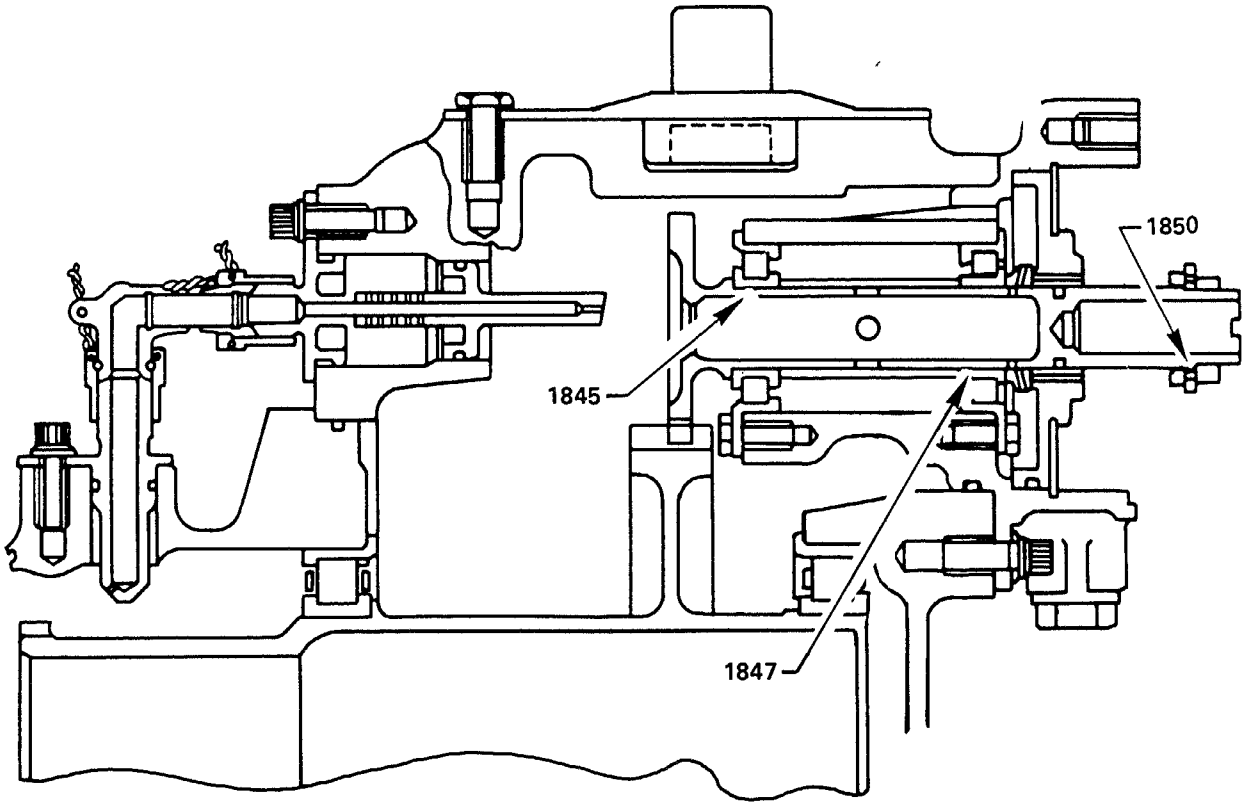


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Fuel Supply Tube Coupling Nuts
Figure 607



REAR VIEW

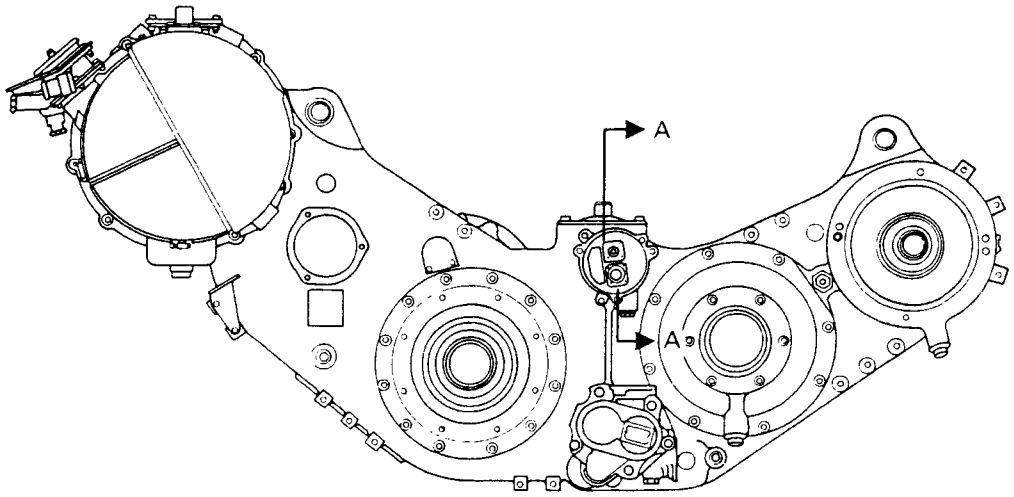


SECTION B-B

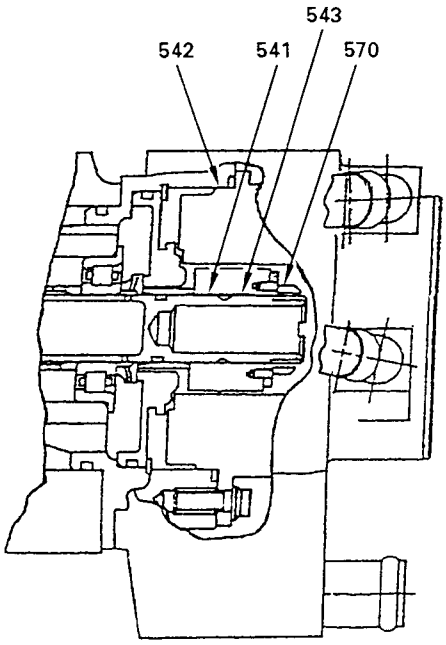
BM5 73 00 00 6 KPMO - 21

L-A2718

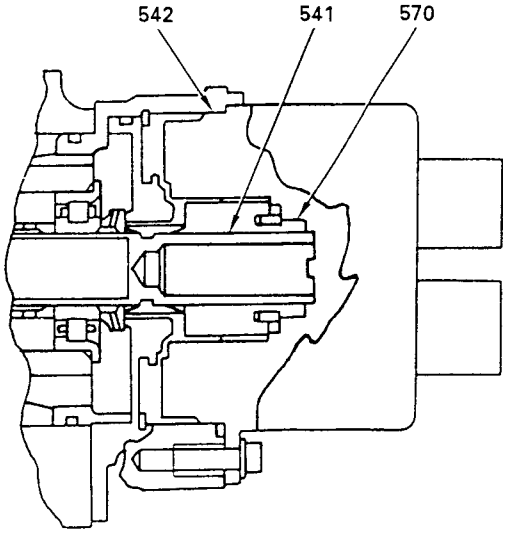
FADEC Generator
Figure 608



REAR VIEW



SECTION A - A
(FOR ENGINES WITH SB PW4ENG 72-375)



SECTION A - A
(FOR ENGINES PRIOR TO SB PW4ENG 72-375)

L-A0659 (0393)

BM5 73 00 00 6 KRMO - 01

FADEC Generator
Figure 609

4. Engine Fuel and (Fuel) Hydraulic System External Part Visual Examination.

A. Equipment and Materials

ITEM	DESIGNATION
(1)	Circuit Breakers Safety Clips
(2)	Access Platform
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors

B. Job Set-Up
(1)Open, safety and tag the appropriate circuit breakers, and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(2)Install access platform.

C. Procedure
(1)Visually examine the external fuel and (fuel) hydraulic system tubes for damage. See Table 602.
NOTE : This inspection procedure does not require tube removal in order to inspect and verify acceptable tube condition.

ITEM	INSPECT FOR	CONTINUE IN SERVICE LIMITS
Fuel System Tubes	Cracks	None Permitted
	Corrosion and Stains	Permitted if it can be removed by light polishing with crocus cloth
	Loose Tube Nuts	None Permitted
	Loose or Broken Lockwire	None Permitted
	Nicks, Scratches, Chafing and Pitting	0.002 in. (0.051 mm) maximum depth permitted in all locations
	Dents (without sharp edges or corners)	Permitted if the tubing OD is not decreased by more than 10% at each location. No dents permitted within 0.25 in. (6.35 mm) or less from the tube ferrule

ITEM	INSPECT FOR	CONTINUE IN SERVICE LIMITS
	Dents (with sharp edges or corners)	None Permitted

Table 602 - Inspection Reference Table
Continue in Service Limits for the Fuel and Hydraulic System Tubes

(2)Visually examine the external fuel and (fuel) hydraulic system tubes for 0.125 in. (3.175 mm) minimum clearance to adjacent tubes or structure.
(a)Minimum clearance between any two adjacent tubes or between one single tube and any other adjacent engine part shall be 0.125 in. (3.175 mm) unless otherwise specified.
(b)Minimum clearance refers only to clearance relative to tube and not to fittings or other attached hardware.
(3)Examine the tubes to make sure they are correctly attached at all support locations.
(a)Replace all worn clamps.
(b)Tighten all loose clamp bolts and brackets at all support points along the tube length.
(c)Tighten all loose tube fittings.
(4)Examine the fuel system tube connections, tube or manifold to component connections, and tube to case boss connections for leaks and loose connections.
(a)No leaks or loose connections permitted.
(b)Make all corrections as necessary.
(5)Examine the fuel manifold B-Nuts at all of the fuel injectors for flaking coke build up.
(a)Flaking coke build up is not permitted.
(b)Replace the fuel manifold and the packings inside the connections as necessary in less than 50 cycles if flaking coke is found.

D. Close-up
(1)Remove access platform.
(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301). Remove safety clips and tags and close circuit breakers.
(3)If applicable, test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

1. Cleaning Requirements After Chemical Contact with Fuel

A. General
This procedure gives direction on how to clean the engine after chemical contact with fuel.

B. Equipment and Materials

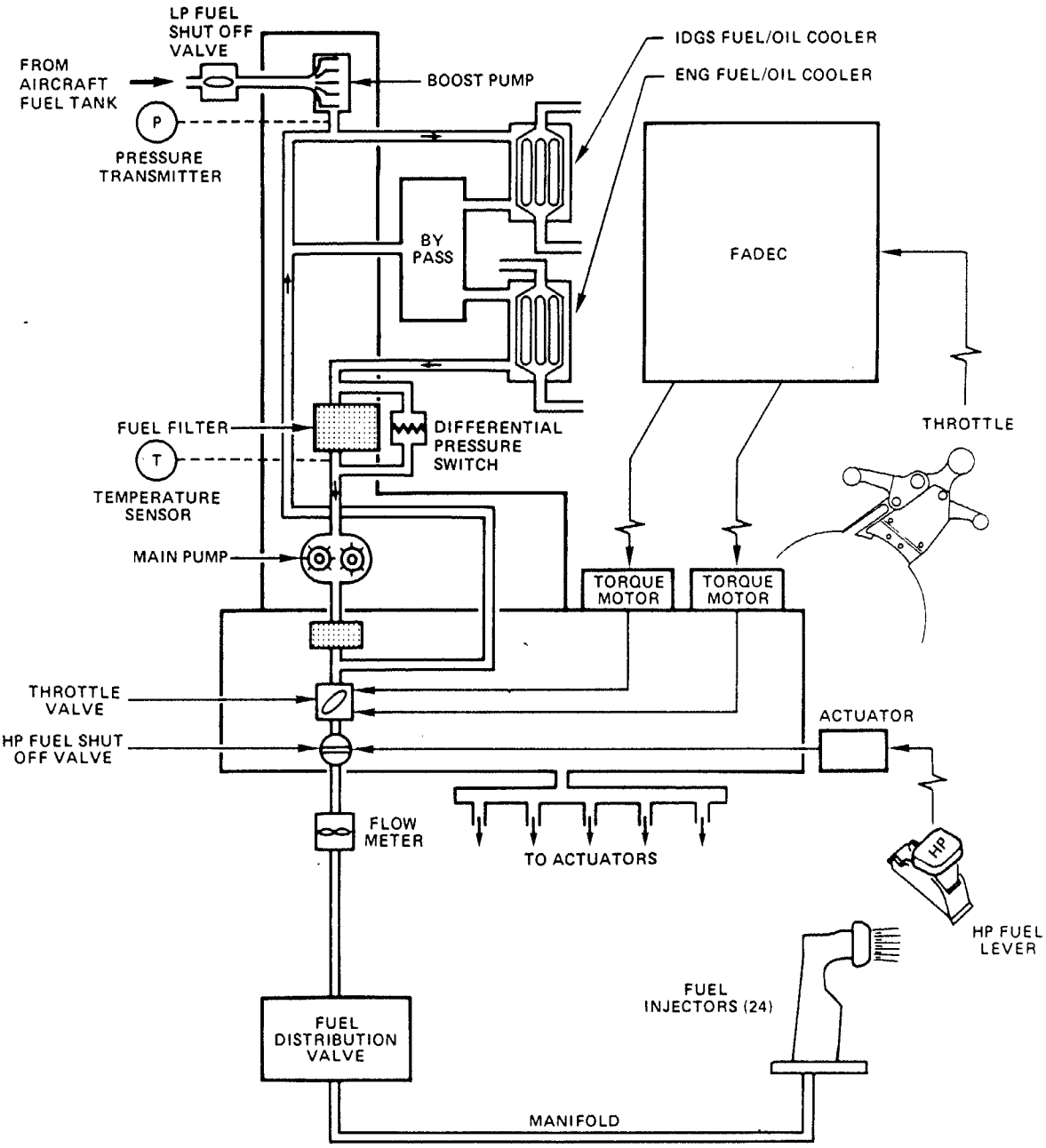
ITEM	DESIGNATION
Referenced Procedure - 70-00-00, P. Block 201	Engine - Standard Practices

C. Procedure
(1) If necessary, clean the engine to remove fuel by SPOP 425 (Ref. 70-00-00, P. Block 201).

DISTRIBUTION - DESCRIPTION AND OPERATION

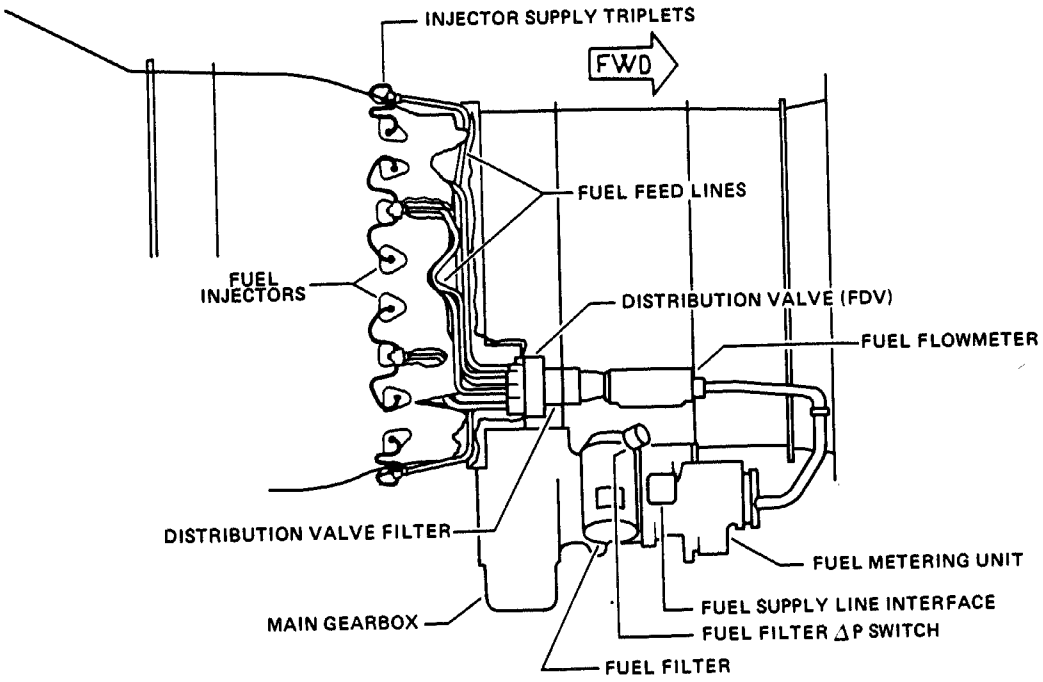
1. General (Ref. Fig. 002)
(Ref. Fig. 001)
The engine fuel distribution and control system provides ice free filtered fuel at pressure and flow rates necessary to meet all engine operating requirements.
The engine fuel distribution and control system consist of :
- an engine driven fuel pump pack
- an IDGS fuel/oil cooler
- an engine fuel/oil cooler
- a fuel metering unit
- a flow dividing valve
- fuel supply manifolds
- 24 injectors
- five actuators.

2. Fuel System Supply and Temperature Conditioning (Ref. Fig. 003)
The engine control system incorporate a two stage gearbox driven fuel pump to supply the fuel for combustion and operating pressure for the hydraulic actuators. The centrifugal boost stage is capable of drawing fuel from the fuel tanks and can operate at up to 0.45 vapor to liquid ratios. Fuel filtration to protect the pressure stage gear pump, actuators and system servo valves is provided between the two pump stages. A fuel pump mounted differential pressure switch is used to provide an indication of filter condition to the flight compartment.
The fuel system de-icing is accomplished through the use of a fuel/oil cooler between the pump stages. The de-icing process is continuous and automatic. It does not require crew action and does not cause engine operating point changes or performance penalties when in operation. It fuel temperature is too high, engine oil flow to the fuel/oil cooler can be bypassed.



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DM5

Fuel System - Schematic
Figure 001

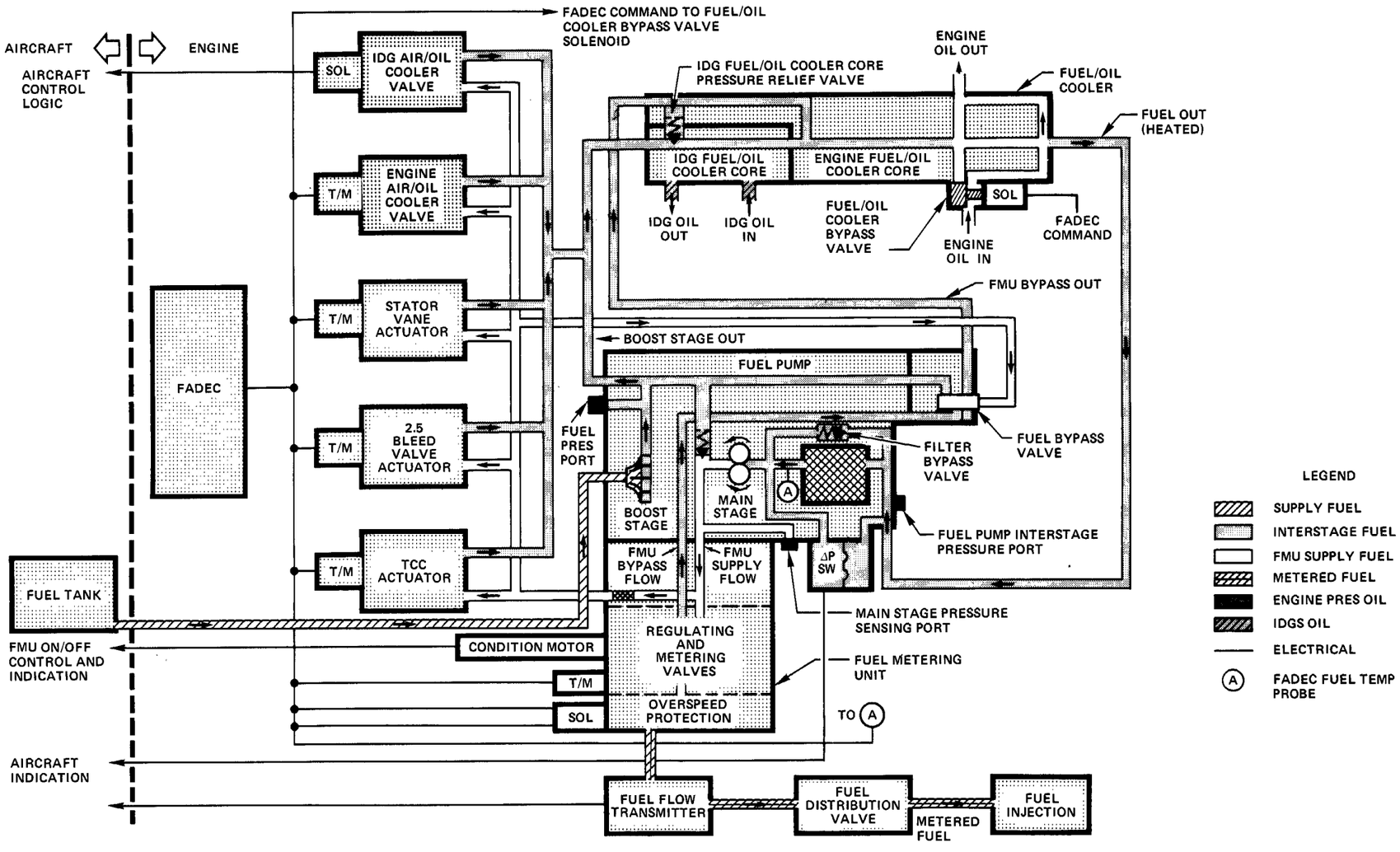


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Fuel Distribution System
Figure 002

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Fuel Distribution Subsystem
Figure 003

PUMPING - DESCRIPTION AND OPERATION

1. General

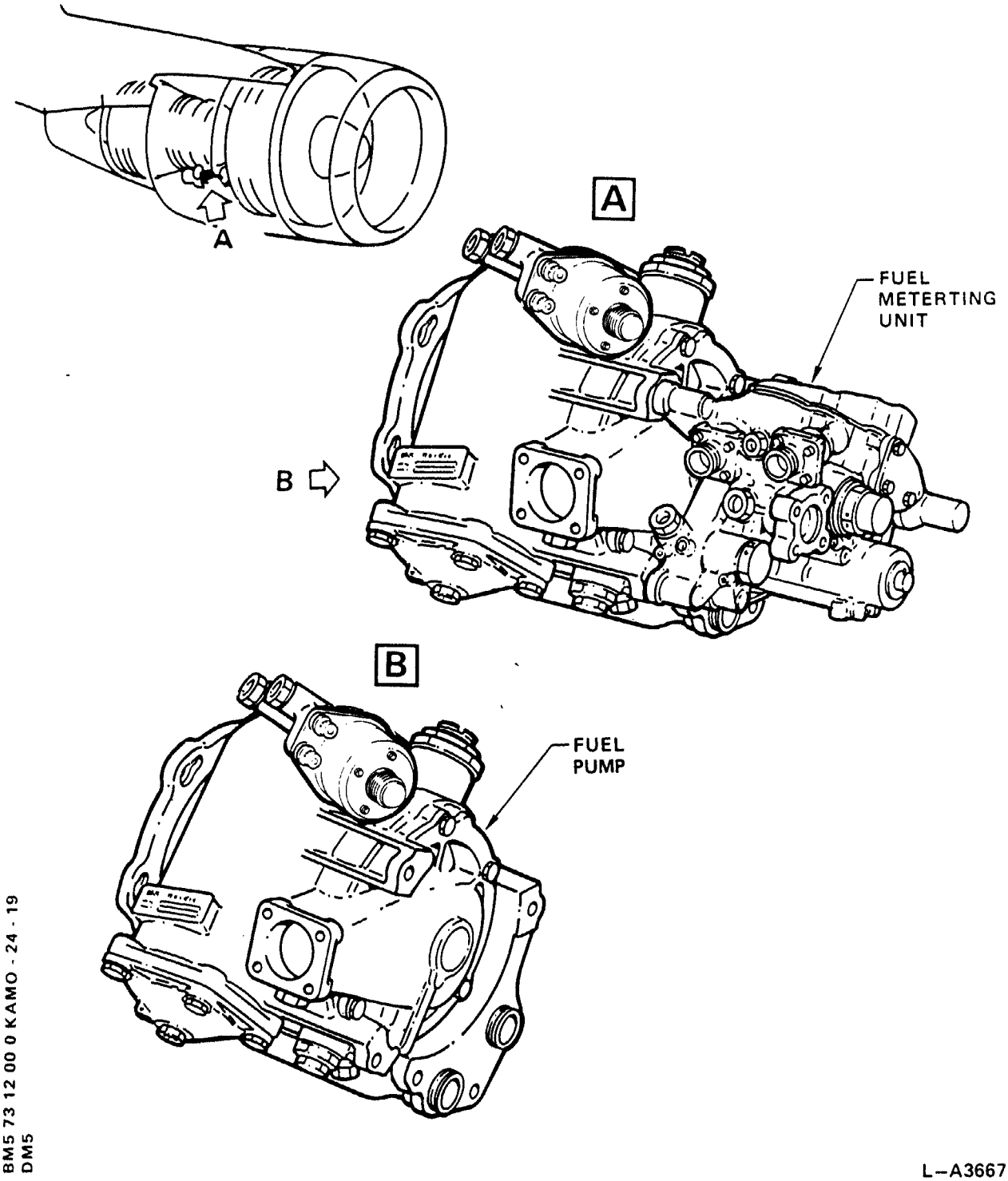
Fuel is supplied from the tanks to the engine driven fuel pumps (input shaft speed = 0,664734 N2).
The engine fuel pump provides interstage fuel to the fuel oil cooler and pressurized main stage fuel to the fuel metering unit for consumption in the burner and for operation of the hydraulic actuators. The actuators position the compressor stator vanes and bleeds, control turbine case cooling air, and control cooling air for the engine and IDGS oil system.

2. Fuel Pump (Ref. Fig. 001, 002, 003)
(Ref. Fig. 004, 005)

The fuel pump pack is attached to the front face of the accessory gearbox, on the right side (Ref. Fig. 001).
The pump consists of a single gear stage fed by a centrifugal boost stage, a 40 micron fuel filter located at gear stage inlet, and provisions to mount the fuel metering unit (Ref. Fig. 003).
Five interface fluid connectors are provided : fuel/oil cooler supply and return, pump inlet ; and supply and return ports for the fuel metering unit (Ref. Fig. 004, 005).
Fuel from the centrifugal boost pump passes at a pressure of up to 320 psia through IDGS and engine fuel/oil coolers and filter to the gear stage. The pump outlet provides fuel to the fuel metering unit at a pressure of up to 1250 psia.
The fuel pump drive shaft external splines are oil lubricated. A gear stage pressure relief valve limits pressure rise across the gear stage to approximately 1400 psi (96.52 bars).

3. Fuel Filter (Ref. Fig. 006)

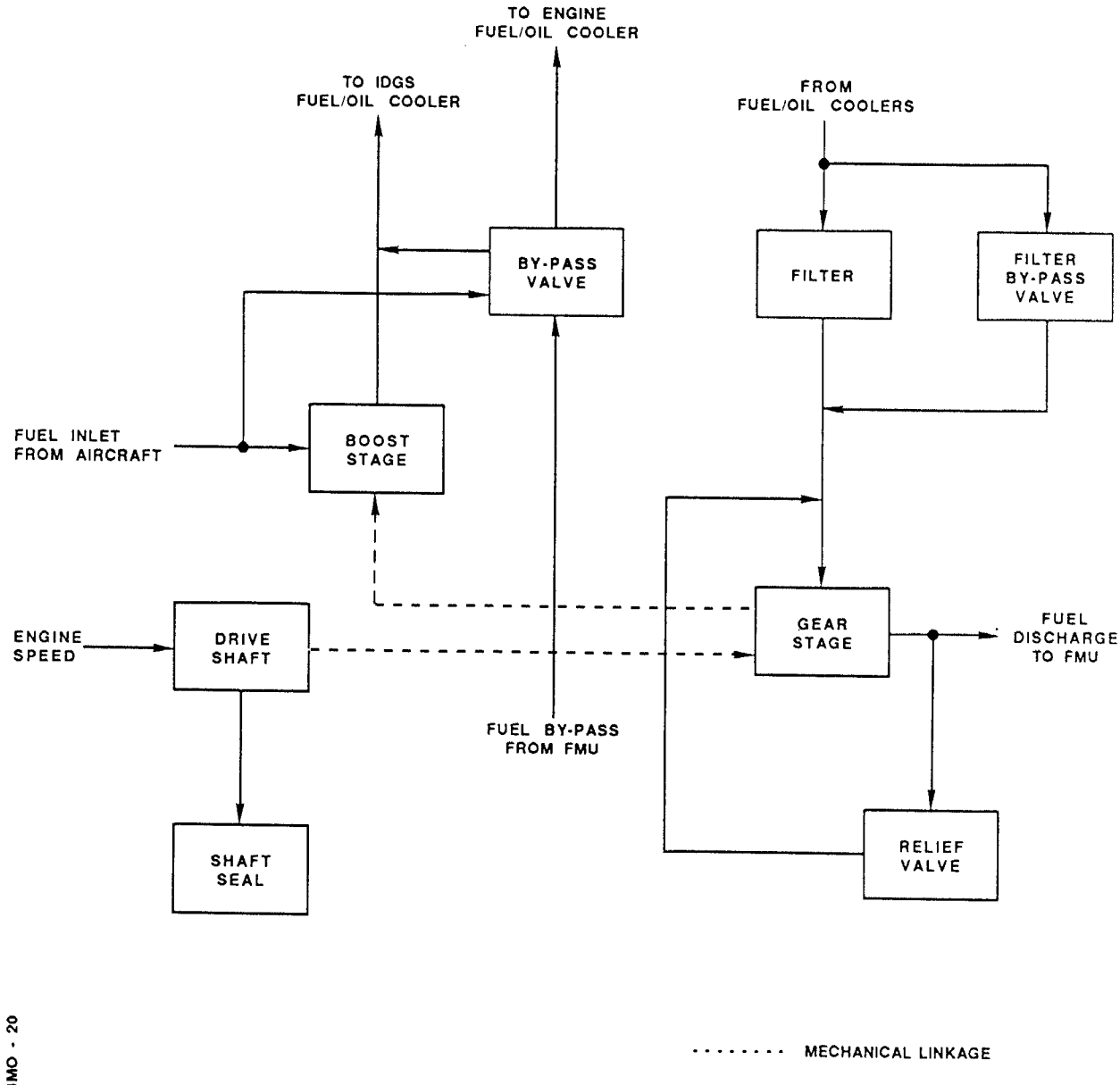
The fuel filter is located in the fuel pump housing. Its function is to protect the engine fuel system from contamination and/or icing.
The filter element (40 micron capability) is of the disposable cartridge type. If the pressure drop across the element exceeds 9 psi (fiter becoming contaminated), the by-pass valve located at the top of the filter housing opens to allow fuel to by-pass the filter element.
The fuel filter differential pressure switch is mounted on the pump housing. It closes at 5.5 psid (±0.7) on increasing pressure and opens at 3.5 psid (±1 psid) on decreasing pressure.



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DM5

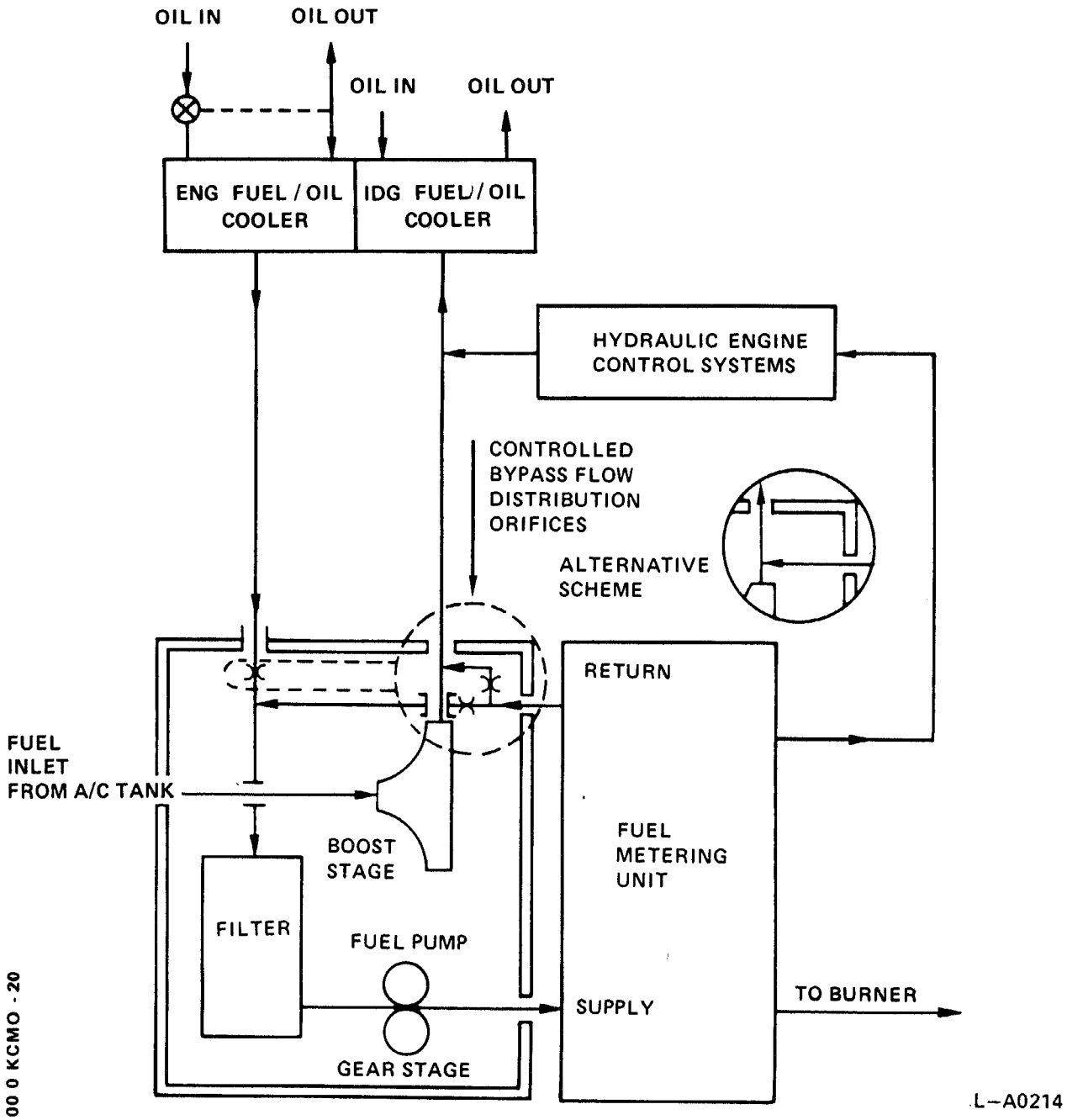
L-A3667

Engine Fuel Pump Location
Figure 001



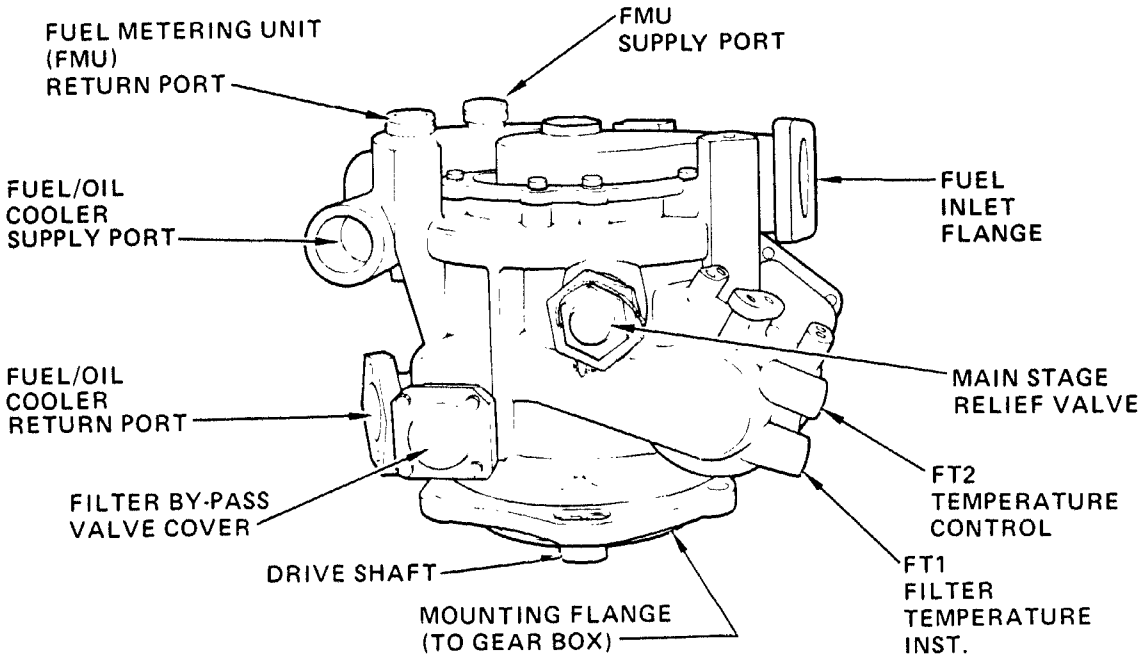
BM5 73 12 00 0 KBMO - 20

Fuel Pump Functional Block Diagram
Figure 002

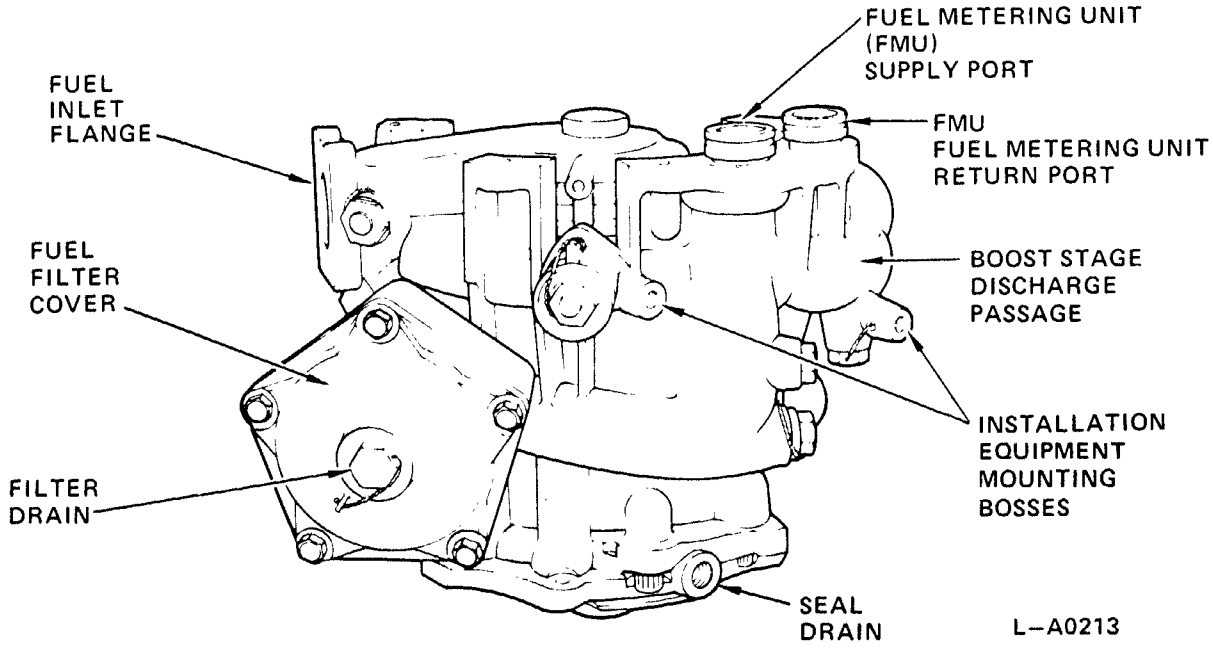


BM5 73 12 00 0 KCMO - 20

Fuel Pump Flow Schematic
Figure 003



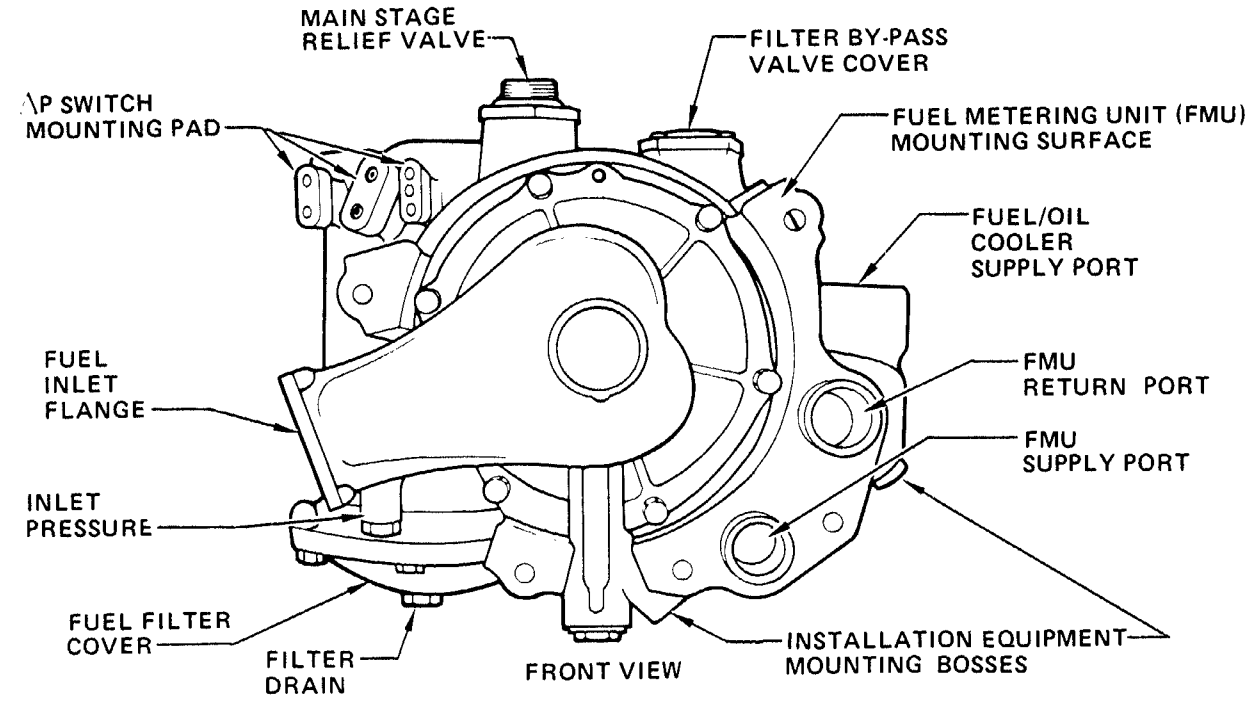
TOP VIEW

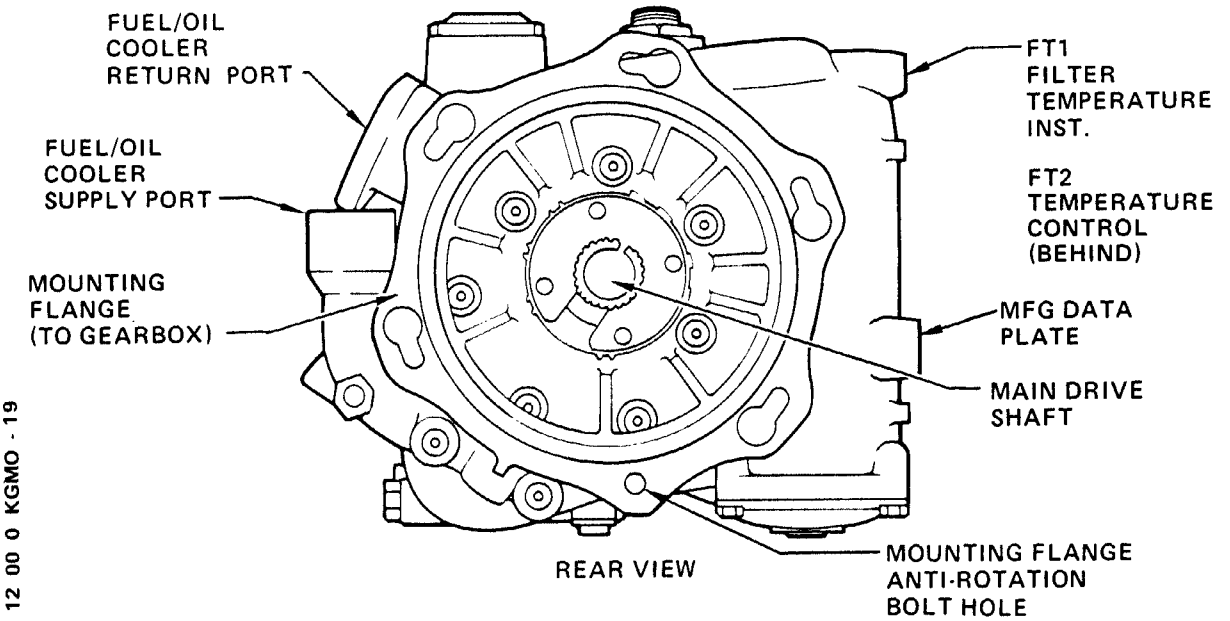


BOTTOM VIEW

BM5 73 12 00 0 KEMO - 19

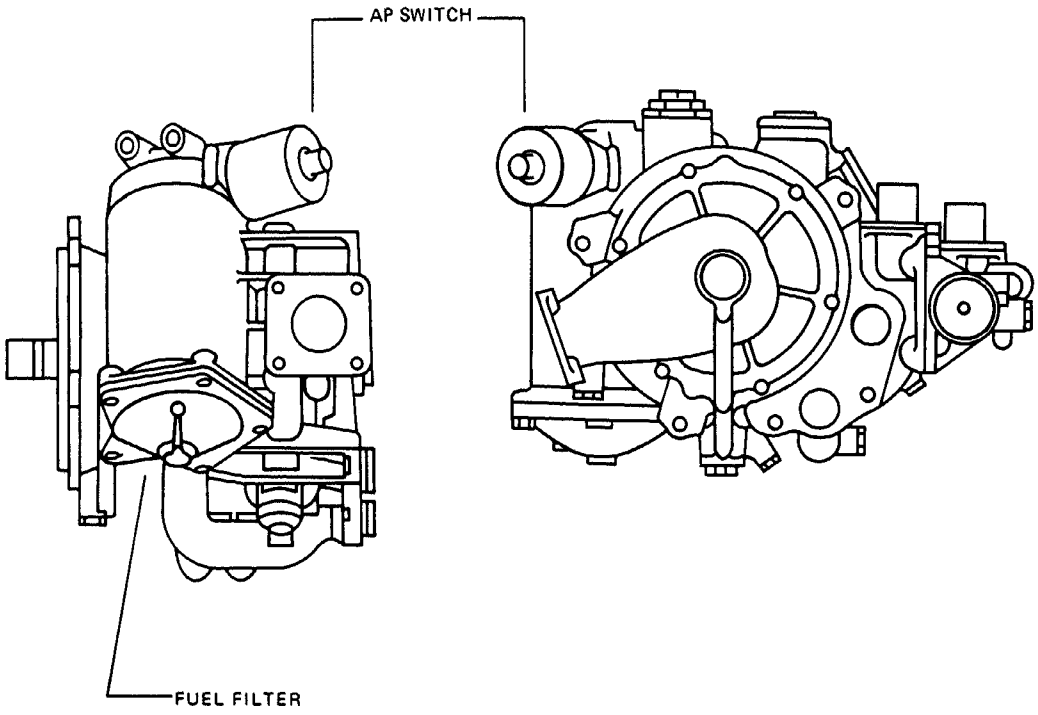
Fuel Pump Flow Schematic
Figure 004

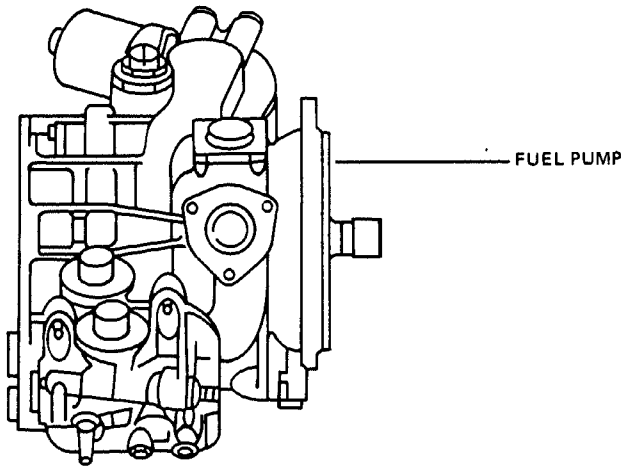




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Fuel Pump Port Identification
Figure 005





BM5 73 12 00 0 KJMO 19

Fuel Filter Access
Figure 006

1. Fuel Pump

A. Equipment and Materials

ITEM	DESIGNATION
(1)	Circuit Breaker Safety Clips
(2)Material No.P03-001	Oils (Ref. 70-00-00)
(3)Material No.P06-002	Lubricants (Ref. 70-00-00)
R (4)Material No.P06-054	Lubricants (Ref. 70-00-00)
(5)	Key Washer
(6)	Packings
(7)	Retainer
(8)	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
(9)	Container 5 US Gallons (19 liters)
10)PWA85862	Torque Adapter
11)PWA85989	Fixture, Handling (Optional)
12)PWA86461	Torque Adapter
13)	Access Platform
Referenced Procedures	
- 70-00-00, P. Block 201	Engine Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 72-65-01, P. Block 701	Main Gearbox
- 73-23-00, P. Block 401	Fuel Metering Unit
- 73-12-02, P. Block 401	Fuel Bypass Valve

B. Procedure

(1)Job set-up

(a)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(b)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENGINES/ENG1 FUEL FILTER	1EL	332/V72
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
For engine 2			
133VU	ENGINES/ENG2 FUEL FILTER	2EL	332/U72
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(c)Install access platform.

(d)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301)

(e)Remove fuel metering unit (Ref. 73-23-00, P. Block 401).
(f)Remove fuel bypass valve (Ref. 73-12-02, P. Block 401).
(2)Removal (Ref. Fig. 401, 402, 403)
(Ref. Fig. 408)
(a)For easier access, remove the forward exciter mount bracket from the main gearbox front face as follows :
1 Remove the three bolts which attach the bracket to the main gearbox front face.
2 Remove the two bolts that attach the exciter mount bracket to the forward exciter mount bracket.
3 Remove the forward exciter mount bracket from the engine.
(b)For easier access for engines equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11) (Post SB PW4ENG 73-35), loosen the hose and tube assembly as follows :
1 Loosen the clamp bolts which attach the hose and tube (FM11) to the Flange J brackets and the No. 3 bearing breather tube AP39.
CAUTION : DO NOT COMPLETELY DISCONNECT THE FM11 COUPLING NUT FROM THE FUEL/OIL COOLER ADAPTER. IF YOU DO, THEN A NEW PREFORMED PACKING MUST BE INSTALLED TO THE FUEL/OIL COOLER ADAPTER.
2 Remove the lockwire or safety cable and loosen the FM11 tube nut no more than four (4) revolutions from the fuel/oil cooler adapter.
3 Attach a tag at the fuel/oil cooler adapter to indicate that a future torque at the connection is necessary.
(c)Disconnect harness connector from fuel pump filter differential pressure switch located on right front side of fuel filter. Install protective closures.
(d)(Pre SB PW4ENG 73-84), disconnect W5P8 harness connector from fuel temperature thermocouple probe located at top, outer side of fuel pump filter. Install protective closures.
(e)(Post SB PW4ENG 73-84), remove the harness connector from the thermocouple probe as follows.
1 Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.
2 Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.
3 Remove the wiring harness terminals from the thermocouple studs.
4 Install protection covers.
(f)Remove fuel pump drain tube assembly as follows :
1 Remove tube nut from fuel pump drain port union at bottom of gearbox.
2 Remove tube nut from drain manifold assembly.
3 Remove tube.
(g)Remove four bolts and washers securing hose assembly to fuel pump. Remove hose and gasket from fuel pump inlet. Discard gasket.
(h)Pre-SB PW4 ENG. No. 73-35
(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Remove lockwire and disconnect oil cooler outlet fuel tube assembly from rearward, inboard adapter on pump. Slide nut away from pump.
2 Remove three bolts securing above adapter to fuel pump and slide adapter away from pump on tube.

(j)Post-SB PW4 ENG. No. 73-35
(For engines equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Remove three bolts securing flange to fuel pump. Disengage hose and tube assembly and discard packing.

(k)Remove three bolts securing oil cooler inlet fuel tube assembly to fuel pump pad on inboard side of pump.
WARNING : STABILIZE AIRPLANE WING ON WHICH ENGINE IS MOUNTED PRIOR TO REMOVING FUEL PUMP OR INJURY TO PERSONEL MAY OCCUR.

(l)For ease of removal, install the PWA85989 Handling Fixture to the fuel pump. Attach it with the two detail bolts and the handscrew.

(m)Using PWA85862 Torque Adapter loosen and remove antirotation bolt from hole in base flange of pump at approximately the 7 o'clock position.
CAUTION : DO NOT ALLOW WEIGHT OF FUEL PUMP TO BE TRANSMITTED TO PUMP SPLINES DURING REMOVAL OR DAMAGE TO SPLINES MAY RESULT.
CAUTION : TO PREVENT INDUCING LOADS INTO THE DRIVE PAD CARBON SEAL, CARE SHOULD BE TAKEN TO PROPERLY ALIGN AND SUPPORT THE COMPONENT DURING REMOVAL.

(n)Use PWA86461 Torque Adapter to loosen the bolt at the 1 o'clock position and PWA85862 Torque Adapter to loosen the remaining bolts securing fuel pump to gearbox drive until captured washers are clear of flange. Rotate pump clockwise (viewed from the front) to disengage flange holes from holes from bolts and remove pump from engine disengaging drive spline.
Lower pump and remove from engine.

(p)While holding fuel pump, remove bolts securing pump to fixture if used. Remove pump.

(q)Remove packings from groove on drive spline and base of pump. Discard packings. Install protective closures to pump.

(r)Remove and discard inlet fuel tube packing.

(s)Pre-SB PW4 ENG. No. 73-35
(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Remove adapter and packing from outlet fuel tube. Remove outlet fuel tube retainer and packing. Straighten tabs of key washer and remove tube nut. Discard retainer, packings, and key washer. Install protective closures.

(t)If fuel pump is to be replaced, comply with the following :
1 Remove bolts and washers securing fuel pump filter differential pressure switch located on upper right front of fuel filter. Remove switch. Discard packings.
2 Remove lockwire and fuel temperature thermocouple probe from port on upper right side of fuel filter. Discard packing.
3 (Post SB PW4ENG 73-84), remove the lockwire from the adapter to the housing. Remove the adapter from the housing.
4 Remove lockwire and plug from port adjacent to fuel temperature port on fuel pump filter. Discard packing.
5 Install protective closures.

(3)Installation (Ref. Fig. 401, 402, 403)
NOTE : Before installation, you can clean seal face of main gearbox for coke or scoring (Ref. 72-65-01, P. Block 701).

(a)If new fuel pump is being installed comply with the following :

1 Lubricate packings with Material No.P06-002, and install packings in raised rectangular pad on upper front side of fuel filter. Position fuel pump filter differential pressure switch to above pad aligning dowel pin and secure with four bolts, threads lubricated with Material No.P03-001, and washers. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m. daN).

2 Install packing lubricated with Material No.P06-002, to plug and install plug threads lubricated with Material No.P03-001, to rear upper port on right side of fuel pump filter housing. TORQUE plug to between 110 and 120 lbf.in. (1.24 and 1.36 m. daN).

3 For thermocouple with a keyway type receptacle (Pre SB PW4ENG 73-84), install probe as follows :

- Install packing lubricated with Material No.P06-002, to fuel temperature thermocouple probe. Install probe, threads lubricated with Material No.P03-001, to port on fuel pump filter housing, forward and adjacent to previously installed plug. TORQUE probe to between 110 and 120 lbf.in. (1.24 and 1.36 m. daN). Wirelock probe and plug.

4 For a thermocouple probe with a studed terminal type receptacle (Post SB PW4ENG 73-84), install probe as follows :

- Install a packing, lubricated with Material No.P06-002, to the adapter of the fuel temperature thermocouple probe.
- Lubricate the threads of the probe with Material No.P03-001, and install the probe and adapter to boss on the upper end of the fuel pump filter housing.
- Remove the lockwire between the adapter and coupling nut. Loosen the coupling nut from the adapter. TORQUE the adapter (to the housing) to between 95 and 100 lbf.in. (1.08 and 1.13 m.daN). Wirelock the adapter to the filter housing.
- Turn the probe so the two larger studs are on the top and to the left as shown in the figure (Ref. Fig.).

  NOTE : Do not install the clamp, ground strap, and bolt to the bracket on the housing at this time.
- The thermocouple probe coupling nut is held loosely to the adapter at this time.

R (b)Lubricate threads of bolts with Material No.P06-054 on main gearbox drive on right, front side of gearbox.

NOTE : Do not install bolt at 7'oclock position. Bolts should be installed until threads are flush with mounting surface.

(c)Pre-SB PW4 ENG. 73-35

For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11), comply with the following :

1 Install new key washer (6) to stopnut (5) on oil cooler outlet fuel tube assembly and install coupling nut (4). Install ferrule (3), new packing (2), lubricated with Material No.P06-002, and retainer (1).

2 Install packing, lubricated with Material No.P06-002, to groove in threaded adapter and install adapter to end of oil cooler outlet fuel tube assembly and slide down tube as far as possible.

(d)Post-SB PW4 ENG. No. 73-35

For engines equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11) :

1 Install packing lubricated with Material No.P06-002 to groove at flanged end of hose and tube assembly.

(e)Install packing lubricated with Material No.P06-002, to groove in upper oil cooler inlet fuel tube assembly. Lubricate adapter.

(f)Lubricate packings with Material No.P06-002, and install to grooves in spline drive and base of fuel pump.

CAUTION : ENSURE ALL PROTECTIVE CLOSURES HAVE BEEN REMOVED. DO NOT ALLOW WEIGHT OF FUEL PUMP TO BE TRANSMITTED TO PUMP DRIVE SPLINES DURING INSTALLATION OR DAMAGE TO SPLINES COULD RESULT.

CAUTION : TO PREVENT INDUCING LOADS INTO THE DRIVE PAD CARBON SEAL, CARE SHOULD BE TAKEN TO PROPERLY ALIGN AND SUPPORT THE COMPONENT DURING INSTALLATION.

(g)For ease of installation, install the PWA85989 Handling Fixture to the fuel pump. Attach it with the two details bolts and the handscrew.

CAUTION : WHILE ROTATING ENTIRE FUEL PUMP DURING INSTALLATION, ALIGN OIL COOLER INLET FUEL TUBE WITH PORT AT TOP INBOARD SIDE OF FUEL PUMP. FAILURE TO DO SO COULD RESULT IN DAMAGE TO PACKING AND/OR FUEL PUMP PORT.

(h)Aligning driveshaft spline and unslotted antirotation hole in flange, install fuel pump over previously installed bolts located in pad on right, front side of main gearbox. Rotate pump counterclockwise and install antirotation bolt, threads lubricated with Material No.P06-054, at 7 o'clock position. Use PWA86461 Torque Adapter to torque the bolt at the 1 o'clock position and PWA85862 Torque Adapter to torque the remaining. TORQUE bolts to between 225 and 250 lbf.in. (2.54 and 2.82 m. daN). Remove fixture if used.

CAUTION : STOPNUT KEY WASHER TABS MUST BE SECURELY CRIMPED OVER FACE OF STOPNUT FLANGE TO RETAIN KEY WASHER ENGAGEMENT WITH STOPNUT. IMPROPERLY SECURED KEY WASHER MAY ALLOW STOPNUT TO LOOSEN CAUSING FUEL LEAK IN ENGINE NACELLE.

R (j)Pre-SB PW4 ENG. No. 73-35

(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)).

Slide oil cooler outlet fuel tube adapter to rear port of pump and secure with three bolts, threads lubricated with Material No.P03-001. Bolt with lockwire holes to be installed in bottom hole of adapter. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN). Lubricate tube nut (4) threads with Material No.P03-001 and TORQUE to between 150 and 160 lbf.in. (1.70 and 1.80 m.daN), loosen then retorque nut (4) to same value. Wirelock tube nut to bottom bolt securing adapter to fuel pump. Handtighten stopnut (5) against stop and back off a maximum one half turn to align with key washer.

Thread engagement between both nuts must be such that a No. 60 wire will not pass through 0.063 in. (1.6 mm) diameter hole (both walls) of stopnut. Crimp key washer in slots and over flange of stopnut.

CAUTION : MAKE SURE YOU INSTALL A NEW PREFORMED PACKING TO THE FM11 TUBE NUT AT THE FUEL/OIL COOLER CONNECTION, LUBRICATED WITH ENGINE OIL (MATERIAL NO.P03-001), IF YOU REMOVED THE TUBE COMPLETELY FROM THE COOLER.

R (k)Post-SB PW4 ENG. No. 73-35

(For engines equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)). Align and engage flanged end to three hole pad on fuel pump. Secure with three bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE bolts to between 85 and 95 lbf.in. (0.97 and 0.10 m.daN). TORQUE the clamp bolts which attach the FM11 and AP39 tubes to the Flange J brackets to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN). (Reference 2170) TORQUE the FM11 tube nut to the adapter on the fuel/oil cooler to between 150 and 160 lbf.in. (0.17 and
R 0.18 m.daN), loosen tube nut to less than 10 lbf.in. (0.11 m.daN) and
R torque again to the same limit. Install Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the tube nut. Remove the tag.

R (l)Secure oil cooler inlet fuel tube flange to three hole pad on fuel pump and secure with bolts, threads lubricated with Material No.P03-001. TORQUE bolts to betweeen 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

R (m)Install new gasket and position hose assembly to fuel pump inlet. Attach with four washers and bolts. TORQUE bolts to between 180 and 200 lbf.in. (2.04 and 2.25 m.daN) and wirelock.

R (n)Install fuel pump drain tube assembly :

1 Position tube to fuel pump drain port union at bottom of gearbox. Tighten tube nut fingertight.

2 Position tube to drain manifold assembly. TORQUE tube nut at both ends of tube to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN).

R (p)Remove closure from fuel pump filter differential pressure switch and connect harness to switch. Tighten handtight until locked in place.

R (q)Remove protective closures. Connect W5P8 harness connector to fuel temperature probe on fuel pump filter housing as follows :

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

1 (Pre SB PW4ENG 73-84) Align connector keyway and push harness connector into mating receptacle. While pushing inward on connector, tighten coupling ring handtight. Connector is proprely secured when color band closest to threads is fully covered by coupling ring.

2 (Post SB PW4ENG 73-84), for a thermocouple probe with a studded terminal type receptacle install the wiring harness as follows.

- Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.
- Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

- (Reference 2167) Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE

COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.

- Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.
  CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.
- (Reference 2163) TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).
- (Reference 2164) TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).
- Install lockwire from the coupling nut to the adapter.
- TORQUE the bolt that attaches the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

R (r)If the forward exciter mount bracket was removed, install the bracket to the main gearbox front face as follows :

1 Install the forward exciter mount bracket to the front face of the main gearbox with bolts, threads lubricated with Engine Oil (Material No.P03-001).

2 Align the outer end of the bracket to the rear face of the exciter mount bracket with bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. Bolt heads forward against exciter mount bracket.

3 Tighten and TORQUE the bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

(4)Close-up

(a)Install fuel bypass valve (Ref. 73-12-02, P. Block 401).
(b)Install fuel metering unit (Ref. 73-23-00, P. Block 401).
(c)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(d)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(e)Remove safety clips and tags and close circuit breakers : 1EL, 35KS, 37KS, 2EL, 34KS, 36KS.
(f)Remove access platform.
(g)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(h)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

2. Fuel Pump and Fuel Metering Unit (Package)

A. Equipment and Materials

ITEM	DESIGNATION
(1)PWA85862	Torque Adapter
(2)PWA85989	Fixture, Handling (Optional)
(3)Material No.P03-001	Oils (Ref. 70-00-00)
(4)Material No.P06-002	Lubricants (Ref. 70-00-00)
(5)Material No.P06-054	Lubricants (Ref. 70-00-00)

ITEM	DESIGNATION
(6)	Keywasher
(7)	Packings
(8)	Retainers
(9)	Corrosion Resistant Steel Lockwire (MS20995C32-AS3214-02) (Ref. 70-00-00)
10)	Access platform
11)	Container 5 US Gallons (19 liters)
12)PWA86461	Torque Adapter
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-02, P. Block 401	Fuel Bypass Valve

B. Procedure

(1)Job set-up

(a)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(b)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENGINES/ENG1 FUEL FILTER	1EL	332/V72
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
For engine 2			
133VU	ENGINES/ENG2 FUEL FILTER	2EL	332/U72
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(c)Install access platform.

(d)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301)

(e)Remove fuel bypass valve (Ref. 73-12-02, P. Block 401).

(c)Disconnect the DH10 connector from the electrical connector on the inboard side of the fuel metering unit.

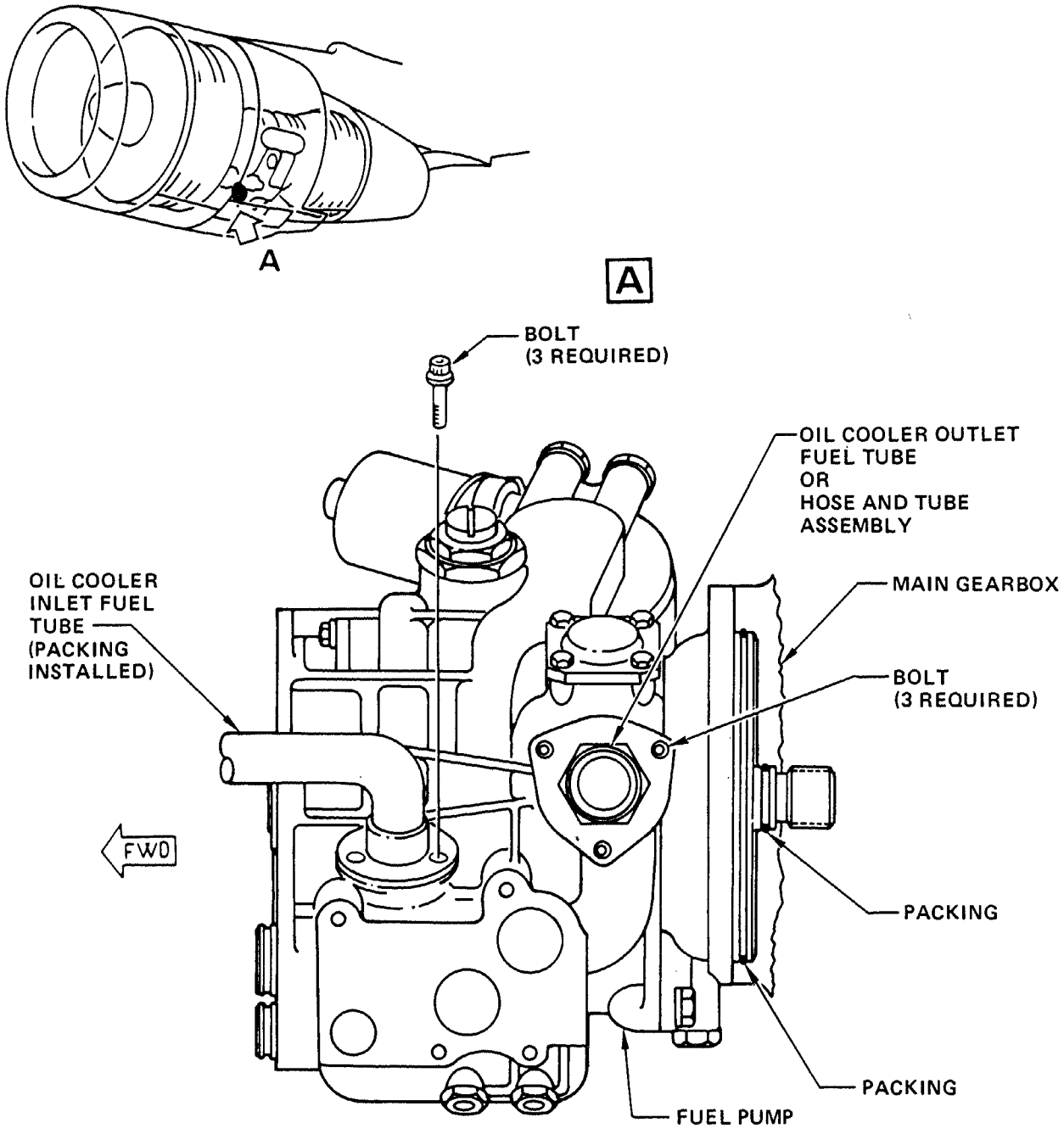
(d)Install protective closures

(2)Removal (Ref. Fig. 404, 405, 408)

(a)Disconnect W4P2 and W5P1 harness connectors from fuel metering unit Install protective closures.

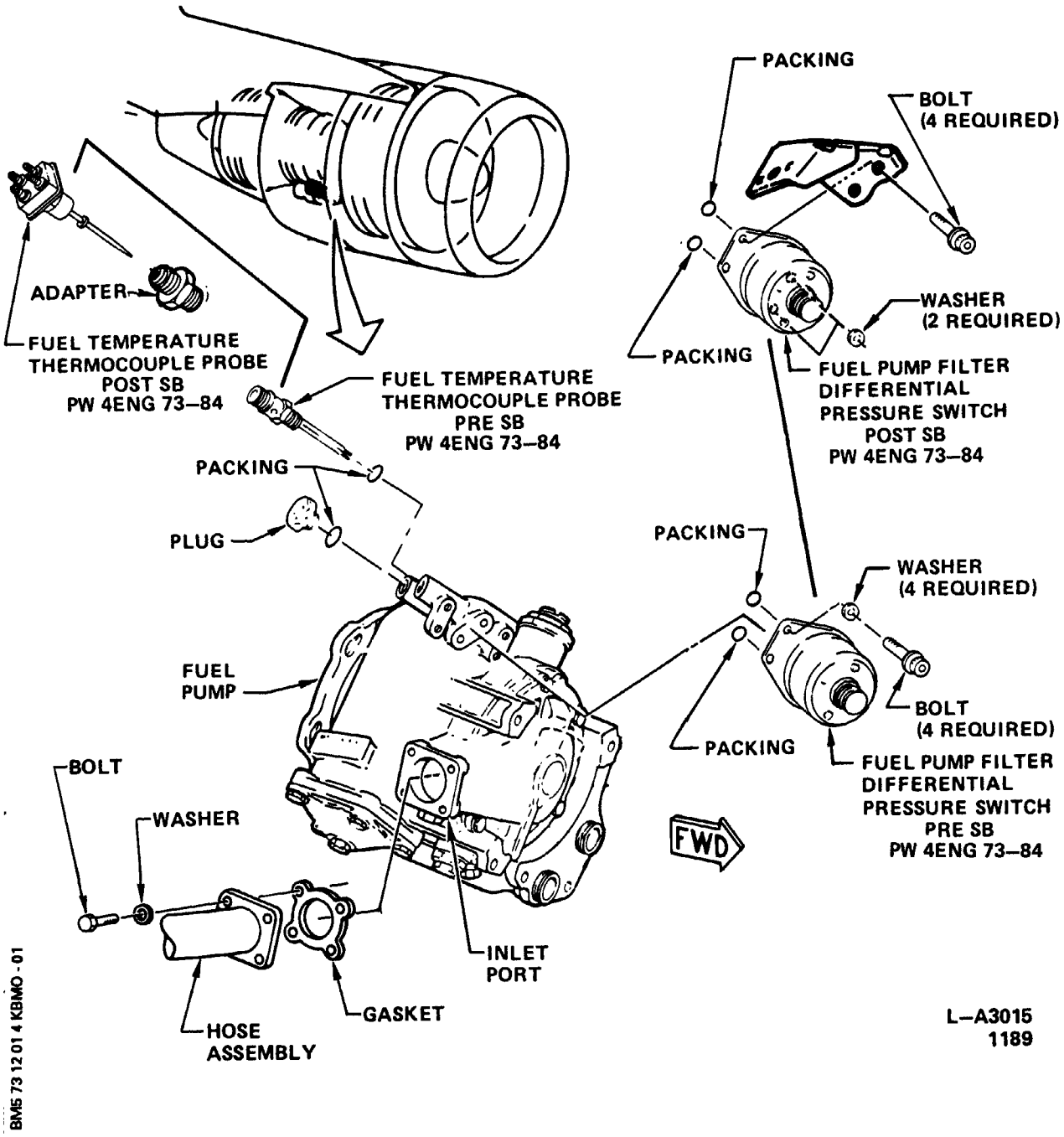
(b)Remove lockwire and disconnect fuel distribution valve supply tube assembly from adapter on fuel metering unit and from adapter on fuel flowmeter.

R (c)If equipped with the fuel metering unit integral actuator, disconnect
R the DH10 connector from the electrical connector on the inboard side
R of the fuel metering unit. Install protective closures.

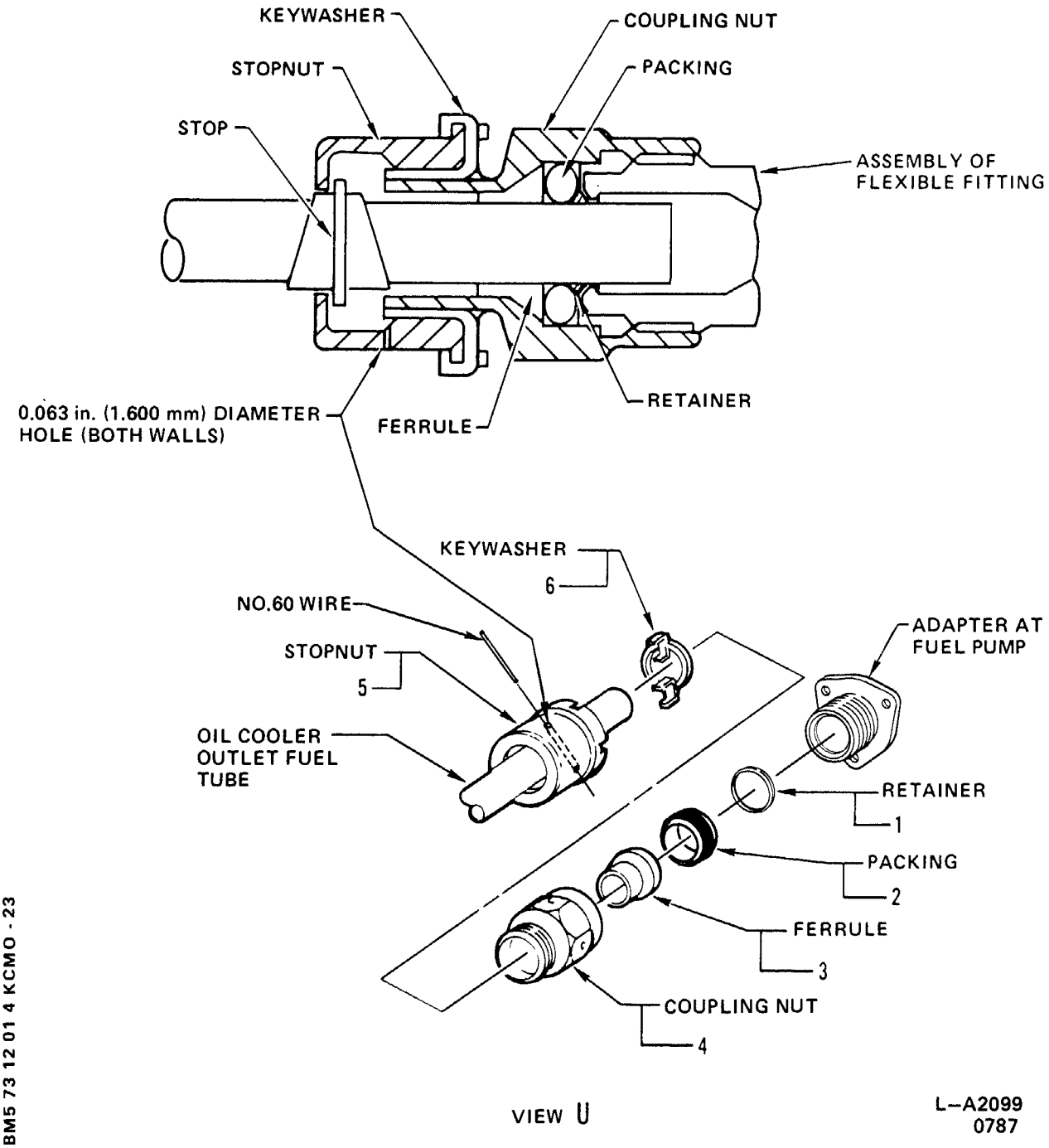


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DM5

Fuel Pump (Fuel Metering Unit and Bypass Valve Removed)
Figure 401



Fuel Pump
Figure 402



Assembly of Flexible Fitting Keywasher and Stopnut
(Pre-SB PW4 ENG. No. 73-35)
Figure 403

R (d)Remove bolts, nuts, and clamps securing tube to HPC case bracket and airframe cooler oil outlet tube. Remove tube from engine. Discard packings and retainers (Ref. Fig. 405).

R (e)Disconnect electrical connector from fuel pump filter differential pressure switch located on upper right side of fuel filter.

R (f)(Pre SB PW4ENG 73-84), disconnect W5P8 connector from fuel temperature thermocouple probe located at top, outer side of fuel pump filter housing.

R (g)(Post SB PW4ENG 73-84), remove the harness connector from the thermocouple probe as follows.

1 Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.

2 Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.

3 Remove the wiring harness terminals from the thermocouple studs.

4 Install protection covers.

R (h)Remove fuel pump drain tube assembly as follows.

1 Remove tube nut from fuel pump drain port union at bottom of gearbox.

2 Remove tube nut from drain manifold assembly.

3 Remove tube.

R (j)Remove four bolts and washers securing hose assembly to fuel pump. Remove hose and gasket from fuel pump inlet. Discard gasket.

R (k)Pre-SB PW4 ENG. No. 73-35

(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)).

1 Remove lockwire and disconnect oil cooler outlet fuel tube assembly from rearward, inboard adapter on fuel pump. Remove three bolts securing threaded adapter to pump. Slide adapter out of pump port and down tube as far as possible.

R (l)Post-SB PW4 ENG. No. 73-35

(For engines equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)).

1 Remove three bolts securing flange to fuel pump. Disengage hose and tube assembly and discard packing.

R (m)Remove bolts securing oil cooler inlet fuel tube flange to fuel pump pad just forward of above outlet fuel tube.

WARNING : STABILIZE AIRPLANE WING ON WHICH ENGINE IS MOUNTED PRIOR TO REMOVING FUEL PUMP OR INJURY TO PERSONNEL MAY OCCUR.

R (n)For ease of removal, install the PWA85989 Handling Fixture to the fuel pump. Attach it with the two detail bolts and the handscrew.

R (p)Using PWA85862 Torque Adapter loosen and remove antirotation bolt from hole in base flange of fuel pump at approximately the 7 o'clock position.

R (q)Use PWA86461 Torque Adapter to loosen the bolt at the 1 o'clock position and PWA85862 Torque Adapter to loosen the remaining bolts securing fuel pump to gearbox drive until captured washers are clear of flange. Rotate pump clockwise (wiewed from the front) to disengage flange holes from bolts.

CAUTION : DO NOT ALLOW WEIGHT OF FUEL PUMP AND FUEL METERING UNIT PACKAGE TO BE TRANSMITTED TO PUMP SPLINES DURING REMOVAL OR

DAMAGE TO SPLINES MAY RESULT.

CAUTION : TO PREVENT INDUCING LOADS INTO THE DRIVE PAD CARBON SEAL, CARE SHOULD BE TAKEN TO PROPERLY ALIGN AND SUPPORT THE COMPONENT DURING REMOVAL.

R (r)Move fuel pump and fuel metering unit package forward to disengage drive spline and bolts. Lower package and remove from engine.

R (s)While holding fuel pump and metering unit, remove bolts securing package to fixture if used. Remove package from fixture if used.

R (t)Remove packings from groove on drive spline and base of fuel pump. Discard packings.

R (u)Remove and discard packing from upper oil cooler inlet fuel tube.

R (v)Pre-SB PW4 ENG. No. 73-35
(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Remove adapter from oil cooler outlet fuel tube and discard packing.
2 Remove packing and retainer from oil cooler outlet tube. Uncrimp key washer and remove coupling nut, ferrule, and key washer.

R (w)Install protective closures to pump, metering unit openings and tubes.

(3)Installation (Ref. Fig. 403, 404, 405)

(a)Lubricate packings with Material No.P06-002, and position to grooves on drive shaft and base of fuel pump.
CAUTION : ENSURE ALL PROTECTIVE CLOSURES HAVE BEEN REMOVED.

(b)Install packing, lubricated with Material No.P06-002, to oil cooler inlet fuel tube flange groove.

(c)Pre-SB PW4 ENG. No. 73-35
(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Install new key washer (6) and coupling nut (4) to stopnut (5), threads lubricated with Material No.P03-001, to oil cooler outlet fuel tube.
Install ferrule (3), packing (2), lubricated with Material No.P06-002, and retainer (1) to tube.
2 Install packing, lubricated with Material No.P06-002, to groove in threaded adapter and slip adapter on oil cooler outlet fuel tube and slide down tube as far as possible

(d)Post-SB PW4 ENG. No. 73-35
(For engine equipped with flexible oil cooler outlet fuel hose and tube assembly).
1 Install packing lubricated with Material No.P06-002 to groove at flanged end of hose and tube assembly.

(e)Check to ensure bolts (with trapped washers) are in position on pad on right, forward side of gearbox. Lubricate bolt threads lubricated with Material No.P06-054.
NOTE : Do not install bolt to threaded hole on drive pad at 7 o'clock location.
Bolts should be installed until threads are flush with mounting surface.

(f)For ease of installation, install the PWA85989 Handling Fixture to the fuel pump. Attach it with the two detail bolts and the handscrew.
CAUTION : DO NOT ALLOW WEIGHT OF FUEL PUMP AND METERING UNIT PACKAGE TO BE TRANSMITTED TO PUMP SPLINES DURING INSTALLATION OR DAMAGE

TO SPLINES MAY RESULT.
WHILE ROTATING ENTIRE FUEL PUMP DURING INSTALLATION, ALIGN OIL COOLER INLET FUEL TUBE WITH PORT AT TOP INBOARD SIDE OF FUEL PUMP. FAILURE TO DO SO COULD RESULT IN DAMAGE TO PACKING AND/OR FUEL PUMP PORT.

CAUTION : TO PREVENT INDUCING LOADS INTO THE DRIVE PAD CARBON SEAL, CARE SHOULD BE TAKEN TO PROPERLY ALIGN AND SUPPORT THE COMPONENT DURING INSTALLATION.

(g)Position and raise package to align spline and unslotted antirotation hole in pump flange with hole in mounting surface. Move package rearward to engage spline and seat pump flange. Rotate package counterclockwise and install antirotation bolt, threads lubricated with Material No. P06-054, to 7 o'clock position. Use PWA86461 Torque Adapter to torque the bolt at the 1 o'clock position and PWA85862 Torque Adapter to torque the remaining bolts on pump flange to between 225 and 250 lbf.in. (2.54 and 2.82 m.daN). Remove fixture if used.

CAUTION : STOPNUT KEY WASHER TABS MUST BE SECURELY CRIMPED OVER FACE OF STOPNUT FLANGE TO RETAIN KEY WASHER ENGAGEMENT WITH STOPNUT. IMPROPERLY SECURED KEY WASHER MAY ALLOW STOPNUT TO LOOSEN CAUSING FUEL LEAK IN ENGINE NACELLE.

(h)Pre-SB PW4 ENG. No. 73-35
(For engines not equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)).

1 Slide oil cooler outlet fuel tube adapter to rear port of pump and secure with three bolts, threads lubricated with Material No.P03-001. Bolt with lockwire holes to be installed in bottom hole of adapter. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN). Lubricate tube nut threads (4) with Material No.P03-001 and TORQUE to between 150 and 160 lbf.in. (1.70 and 1.80 m.daN), loosen then retorque nut (4) to same value. Lockwire tube nut to bottom bolt securing adapter to pump. Handtighten stopnut (5) against stop and back off a maximum one half turn to align with key washer.
Thread engagement between both nuts must be such that a No. 60 wire will not pass through 0.063 in. (1.6 mm) diameter hole (both walls) of stopnut. Crimp key washer in slots and over flange of stopnut.

R (j)Post-SB PW4 ENG. No. 73-35
(For engines equipped with flexible oil cooler outlet fuel hose and tube assembly (FM11)).

1 Position align and engage flanged end to three hole pad on fuel pump. Secure with three bolts threads lubricated with Material No.P03-001. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

R (k)Install new gasket and position hose assembly to fuel pump inlet. Attach with four washers and bolts. TORQUE bolts to between 180 and 200 lbf.in. (2.03 and 2.25 m.daN) and wirelock.

R (l)Install fuel pump drain tube assembly :

1 Position tube to fuel pump drain port union at bottom of gearbox. Tighten tube nut fingertight.

2 Position tube to drain manifold assembly. TORQUE tube nut at both ends of tube to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN).

R (m)Install packings lubricated with Material No.P06-002, and retainers to

fuel distribution valve supply tube assembly and install tube to adapters, threads lubricated with Material No.P03-001, on fuel metering unit and to adapter on fuel flowmeter handtight only.

R (n)Install bolts, threads lubricated with Material No.P03-001, nut, and clamps securing tube to HPC case bracket and to airframe cooler oil outlet tube. TORQUE bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

R (p)TORQUE tube nuts to between 100 and 110 lbf.in. (1.13 and 1.24 m.daN),
R loosen tube nuts to less than 10 lbf.in. (0.11 m.daN) and torque again to required limit. Wirelock tube nuts.

R (q)Secure oil cooler inlet fuel tube flange to three hole pad on fuel pump with bolts, threads lubricated with Material No.P03-001. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

R (r)Remove protective closures. Connect W4P2 and W5P1 harness connectors to their respective receptacles on fuel metering unit.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

R (s)Remove protective closure and connect electrical connector to fuel pump filter differential pressure switch. Tighten handtight.

R (t)Remove protective closures. Connect W5P8 harness connector to fuel temperature probe on fuel pump filter housing as follows :

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

1 (Pre SB PW4ENG 73-84) Align connector keyway and push harness connector into mating receptacle. While pushing inward on connector, tighten coupling ring handtight. Connector is properly secured when color band closest to threads is fully covered by coupling ring.

2 (Post SB PW4ENG 73-84), for a thermocouple probe with a studded terminal type receptacle install the wiring harness as follows.

- Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.
- Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

- Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE

STUD BOX AGAIN.

- Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.
  CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.
- TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).
- TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).
- Install lockwire from the coupling nut to the adapter.
- TORQUE the bolt that attachs the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

R (u)If equipped with the fuel metering unit integral actuator, connect
R the DH10 connector to the electrical connector on the inboard side of
R the fuel metering unit.

(4)Close-up

(a)Remove protective closures, and connect the DH10 connector to the electrical connector on the inboard side of the fuel metering unit.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(b)Install fuel bypass valve (Ref. 73-12-01, P. Block 401).

(c)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(d)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

(e)Remove safety clips and tags and close circuit breakers : 1EL, 35KS, 37KS, 2EL, 34KS, 36KS.

(f)Remove access platform.

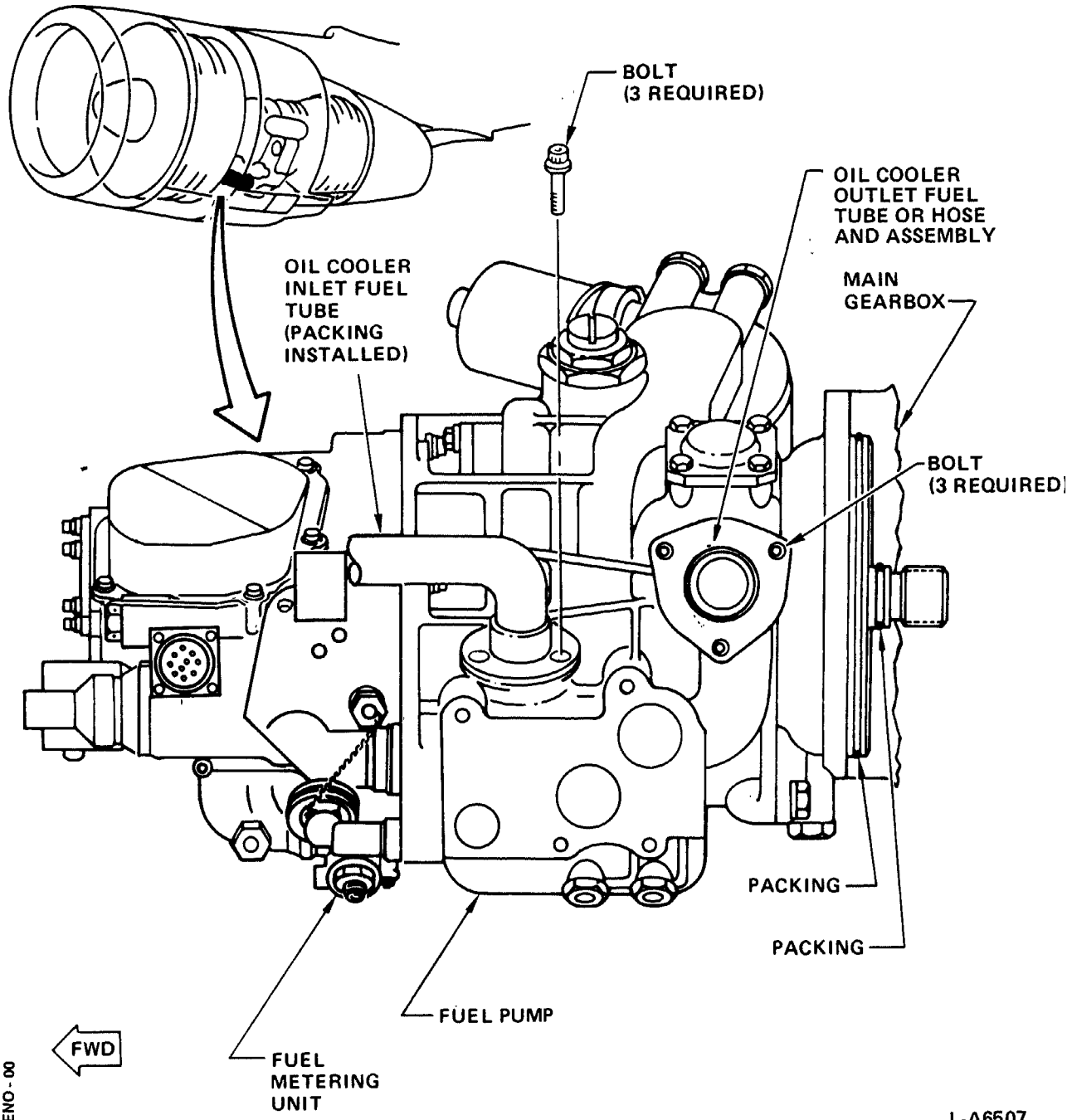
(g)On the appropriate FIRE control module, push fire handle and remove the warning notice.

(h)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

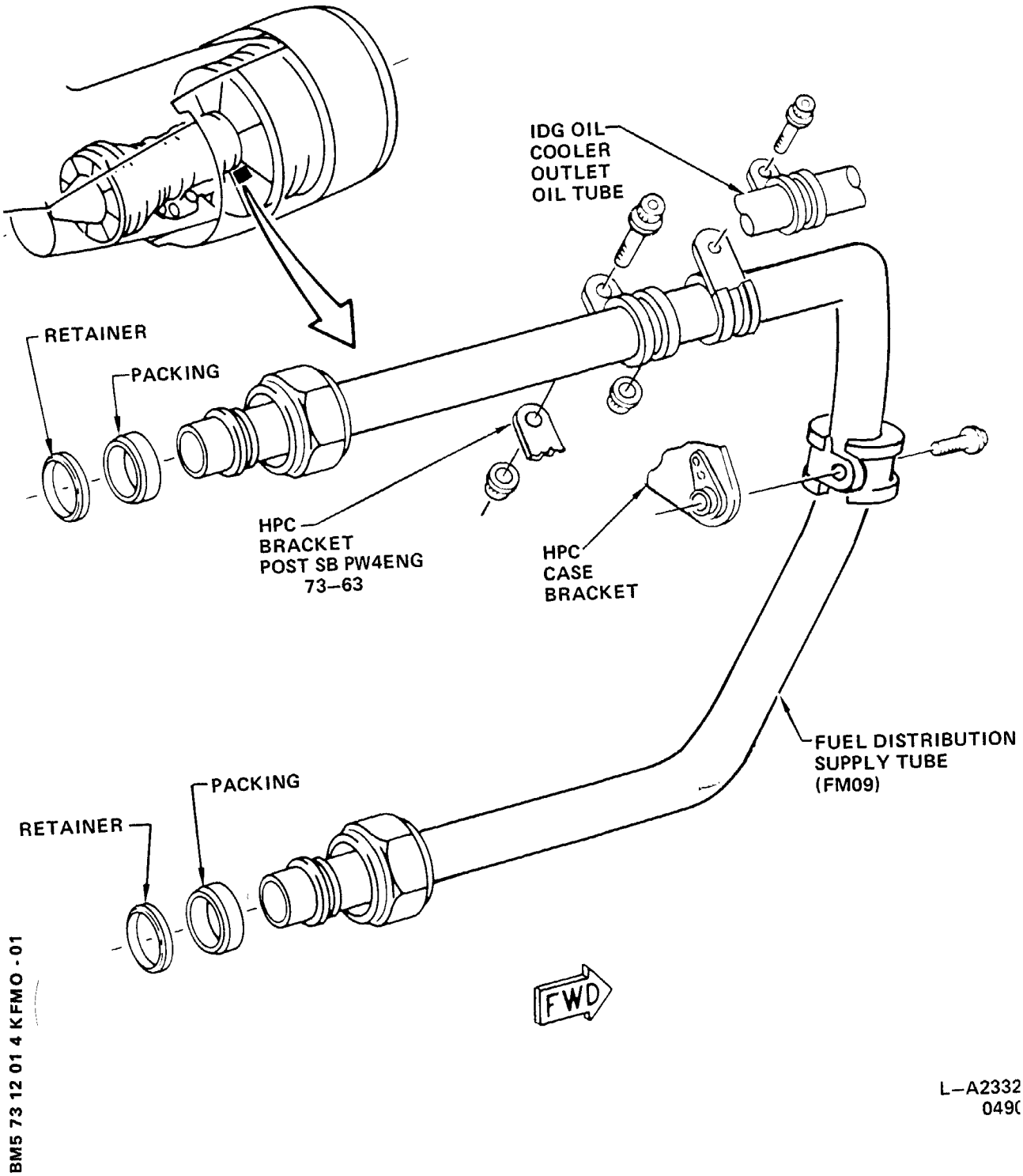
3. Fuel Pump from Fuel Metering Unit (on Bench)

A. Equipment and Materials

ITEM	DESIGNATION
(1)Material No.P03-001	Oils (Ref. 70-00-00)
(2)Material No.P06-002	Lubricants (Ref. 70-00-00)
(3)	Packings
(4)	Torque Wrench
Referenced Procedure	
- 71-00-00, P. Block 501	Power Plant - General



Fuel Pump and Fuel Metering Unit (Package)
Figure 404



Fuel Distribution Valve Supply Tube
Figure 405

B. Procedure

(1)Job set-up

(a)Remove fuel pump and metering unit package (Ref. Paragraph 2).

(2)Removal (Ref. Fig. 407, 406, 408)

(a)Remove nuts, washers and brackets securing fuel pump to fuel metering unit. Separate fuel pump from fuel metering unit.

(b)Remove the transfer tubes from the fuel pump as follows :

1 Remove the packings from fuel pump transfer tubes.

2 Remove the retainers that hold the transfer tubes in the fuel pump.

3 Remove the transfer tubes from the fuel pump and remove the packings from the inner grooves of the transfer tubes.

(c)If new fuel pump is to be replaced, comply with the following :

1 Remove bolts and washers securing fuel pump filter differential pressure switch located on upper right front of fuel filter. Remove switch and bracket if equipped and discard packings.

2 (Pre SB PW4ENG 73-84) Remove lockwire and fuel temperature thermocouple probe from port on upper right side of fuel filter. Discard packing.

3 (Post SB PW4ENG 73-84), remove the thermocouple probe from the housing and the lockwire from the adapter to the housing. Remove the adapter from the housing and discard the packing. Install protection covers.

4 Remove lockwire and plug from port adjacent to fuel temperature port on fuel pump filter. Discard packing.

(d)If new fuel metering unit is to be installed, comply with the following :

1 Remove threaded adapter from port on inboard side of fuel metering unit and discard packing.

2 Remove bolts and bracket securing adapter to outboard fuel supply port on fuel metering unit and remove adapter. Discard packing.

(e)Install protective closures to fuel pump and fuel metering unit.

CAUTION : FUEL METERING UNITS WHICH WILL NOT BE INSTALLED ON ENGINES WITHIN 24 HOURS AFTER REMOVAL MUST BE PRESERVED TO PREVENT INTERNAL CORROSION.

(3)Installation (Ref. Fig. 406, 407)

(a)Remove protective closures from transfer tubes openings on the pump and mating ports on fuel metering unit.

(b)If new fuel pump is being installed, comply with the following :

1 Install fuel pump bypass valve as follows :
Install packings, lubricated with Material No.P06-002, to recesses on fuel pump pad on inboard side. Install fuel pump bypass valve to fuel pump pad aligning boltholes. Secure valve to pump with bolts, threads lubricated with Material No.P03-001. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

2 Lubricate packings with Material No.P06-002, and install two packings in raised rectangular pad on upper front side of fuel filter. Position fuel pump filter differential pressure switch to pad aligning dowel pin and secure with four bolts, threads lubricated with Material No.P03-001, bracket if equipped and washers. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN). (Ref. Fig. 407)

3 Install packing, lubricated with Material No.P06-002, to plug and

install plug, threads lubricated with Material No.P03-001, to rear upper port on right side of fuel pump filter housing. TORQUE plug to between 110 and 120 lbf.in. (1.24 and 1.36 m.daN).

4 For thermocouple with a keyway type receptacle (Pre SB PW4ENG 73-84), install probe as follows :
- Install packing, lubricated with Material No.P06-002, to fuel temperature thermocouple probe. Install probe, threads lubricated with Material No.P03-001, to port on fuel pump filter housing, forward and adjacent to previously installed plug. TORQUE probe to between 110 and 120 lbf.in. (1.24 and 1.36 m.daN). Wirelock probe and plug.

5 For a thermocouple probe with a studed terminal type receptacle (Post SB PW4ENG 73-84), install probe as follows :
- Install a packing, lubricated with Material No.P06-002, to the adapter of the fuel temperature thermocouple probe.
- Lubricate the threads of the probe with Material No.P03-001, and install the probe and adapter to boss on the upper end of the fuel pump filter housing.
- Remove the lockwire between the adapter and coupling nut. Loosen the coupling nut from the adapter. TORQUE the adapter (to the housing) to between 95 and 100 lbf.in. (1.08 and 1.13 m.daN). Wirelock the adapter to the filter housing.
- Turn the probe so the two larger studs are on the top and to the left as shown in the figure. (Ref. Fig. 407)
- TORQUE the coupling to between 95 and 100 lbf.in. (1.08 and 1.13 m.daN). Wirelock the coupling to the adapter.

(c) If new fuel metering unit is being installed, comply with the following :

1 Install new packing lubricated with Material No.P06-002, to adapter and install adapter and bracket to fuel supply port on fuel metering unit. Secure with bolts, threads lubricated with Material No.P03-001. One of four bolts with lockwire holes to be installed in bottom. TORQUE bolts to between 65 and 85 lbf.in. (0.73 and 0.96 m. daN).

2 Install new packing, lubricated with Material No.P06-002, to adapter and install adapter, threads lubricated with Material No.P03-001, to port on fuel metering unit. TORQUE adapter to between 200 and 225 lbf.in. (2.26 and 2.54 m.daN).

(d) Install packings lubricated with Lubricant, Material No.P06-002, to transfer tubes on fuel pump.

(e) Install the transfer tubes to the fuel pump as follows :

1 Lubricate two new small packings and two new large packings with Material No.P006-002.

2 Install one packing to both of the transfer tubes.

3 Install the transfer tubes, packing side inward, to the fuel pump ports.

4 Install the retainers to hold the transfer tubes in position in the fuel pump.

5 Install the remaining packings to the transfer tubes on the fuel pump.

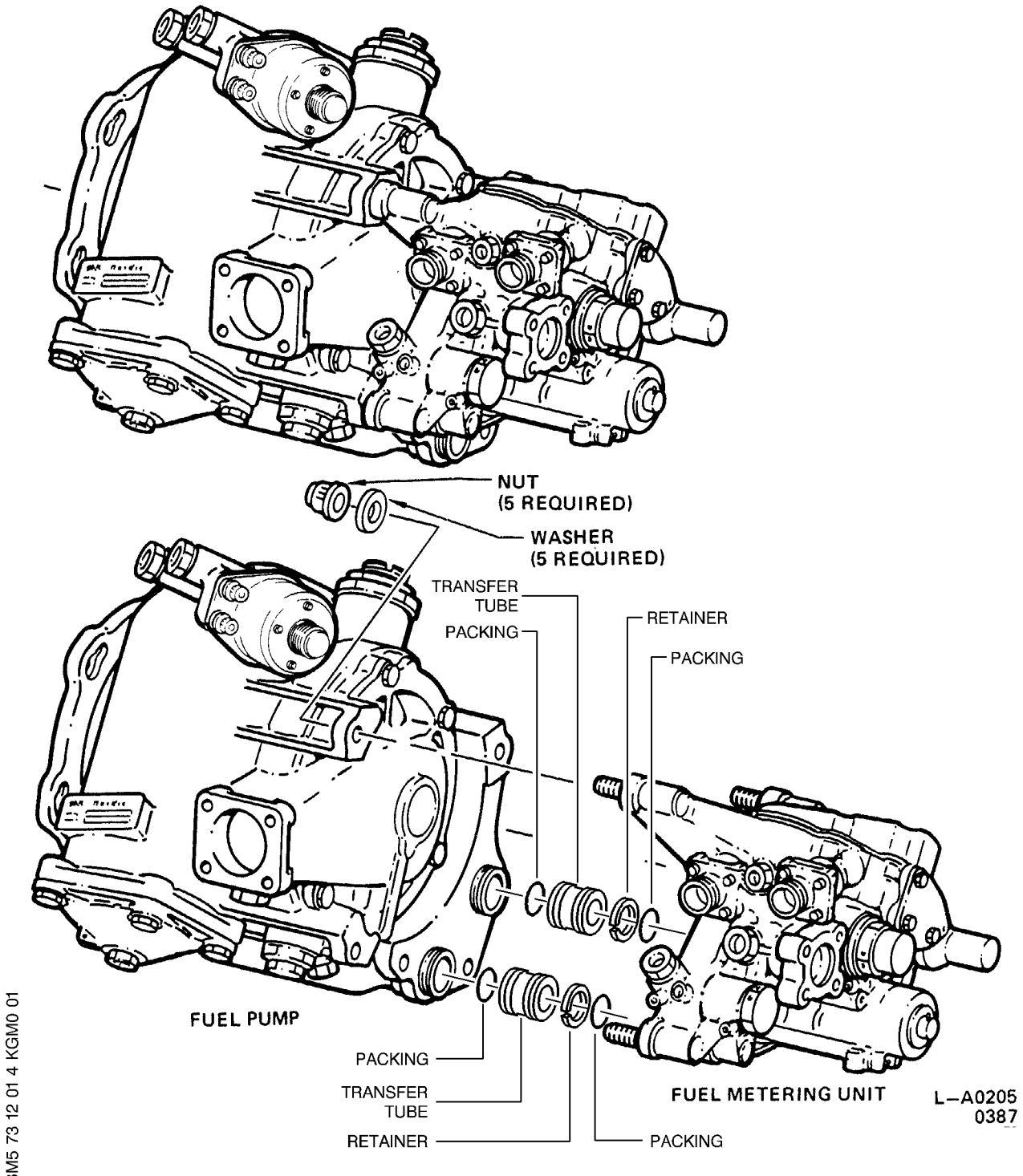
(f) Lubricate threads of studs on fuel metering unit with Material No.P03-001, and aligning transfer tubes on pump with ports on metering unit, install pump to fuel metering unit and secure with washers,

brackets (angle forward) and nuts. TORQUE nuts to between 290 and 325 lbf.in. (3.28 and 3.67 m.daN).

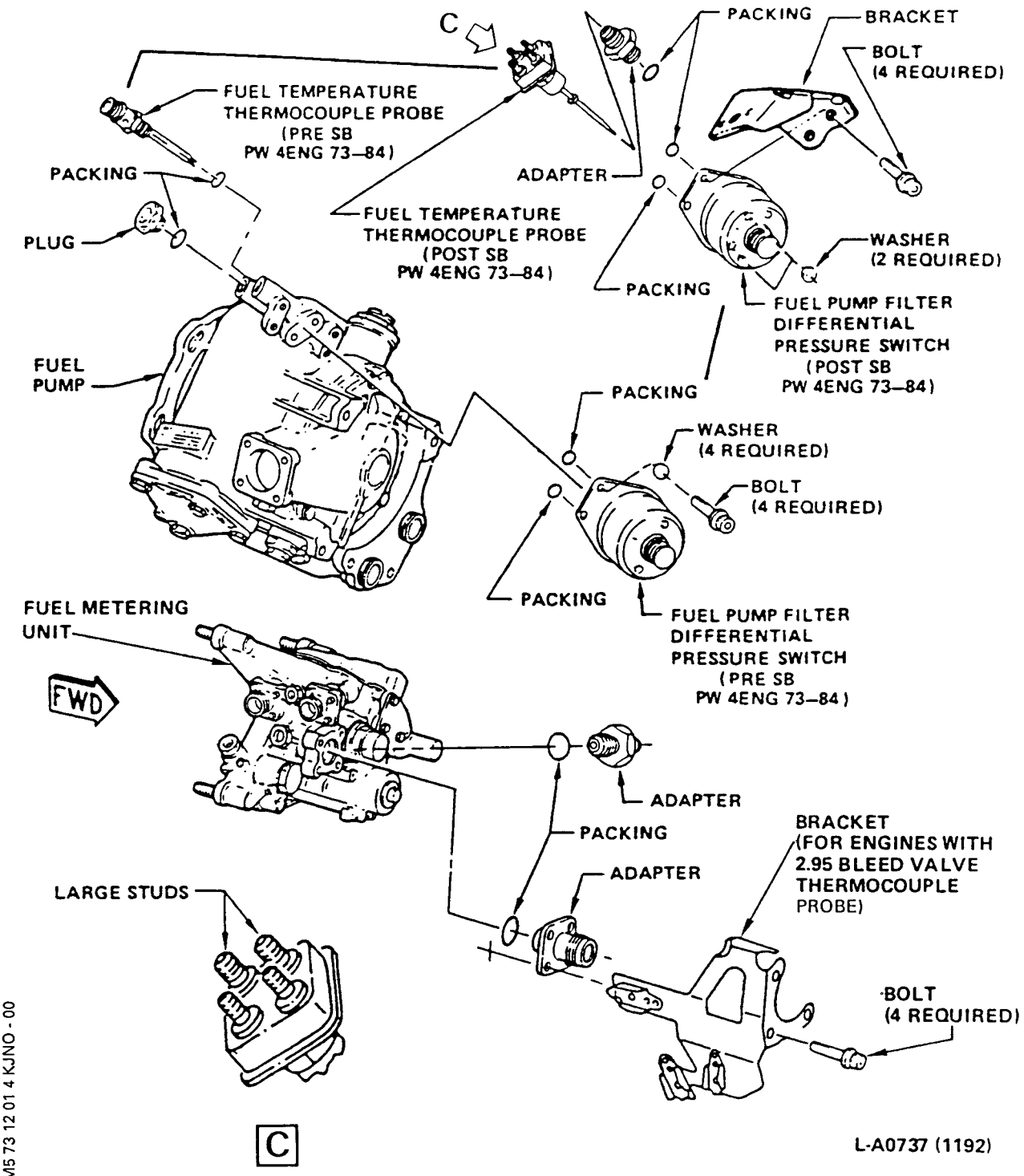
(4)Close-up

(a)Install fuel pump and fuel metering unit package (Ref. paragraph 2.).

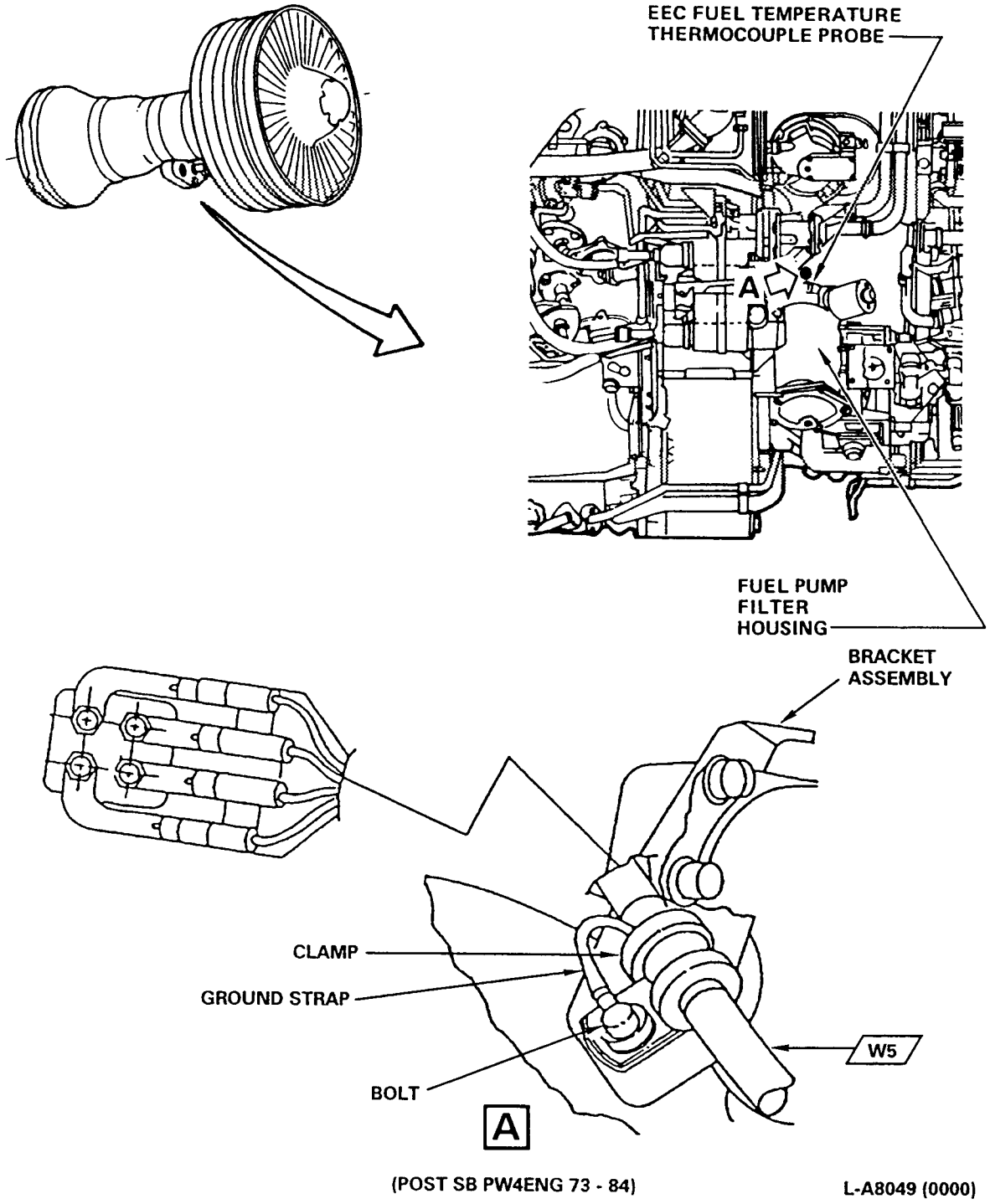
(b)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



Fuel Pump and Fuel Metering Unit
Figure 406



Fuel Pump and Fuel Metering Unit Flange Brackets
Figure 407



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Fuel Pump and Fuel Metering Unit
(Post SB PW4ENG 73-84)
Figure 408

FUEL BYPASS VALVE - REMOVAL/INSTALLATION

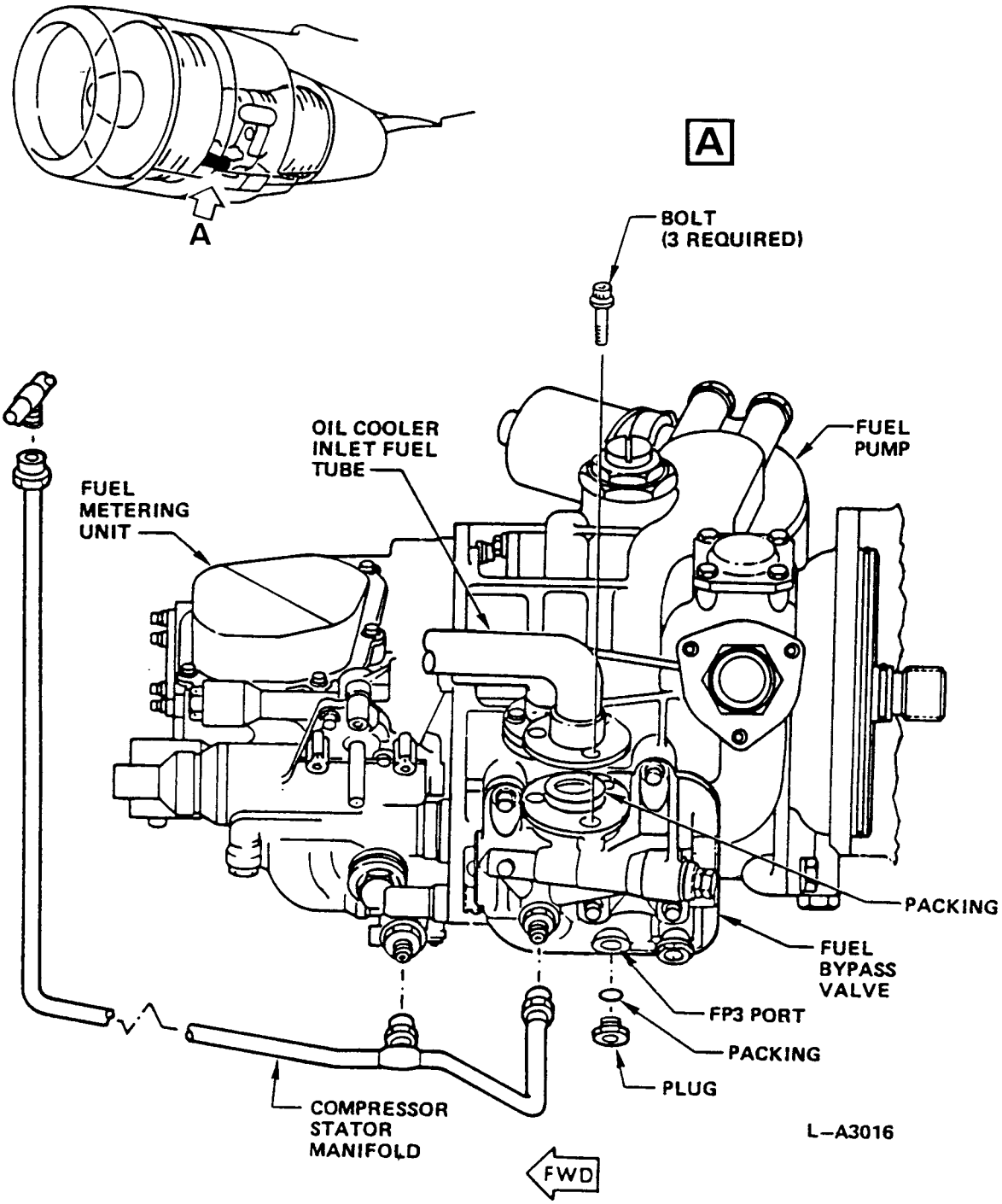
1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B. Material No.P03-001	Oils (Ref. 70-00-00)
C. Material No.P06-002	Lubricants (Ref. 70-00-00)
D.	Packings
E.	Corrosion Resistant Steel Lockwire (AS3214-0 or MS20995C32) (Ref. 70-00-00)
F.	Torque Wrench
G.	Container Min. Capacity 5 US. Gal. (19l)
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors

2. Procedure

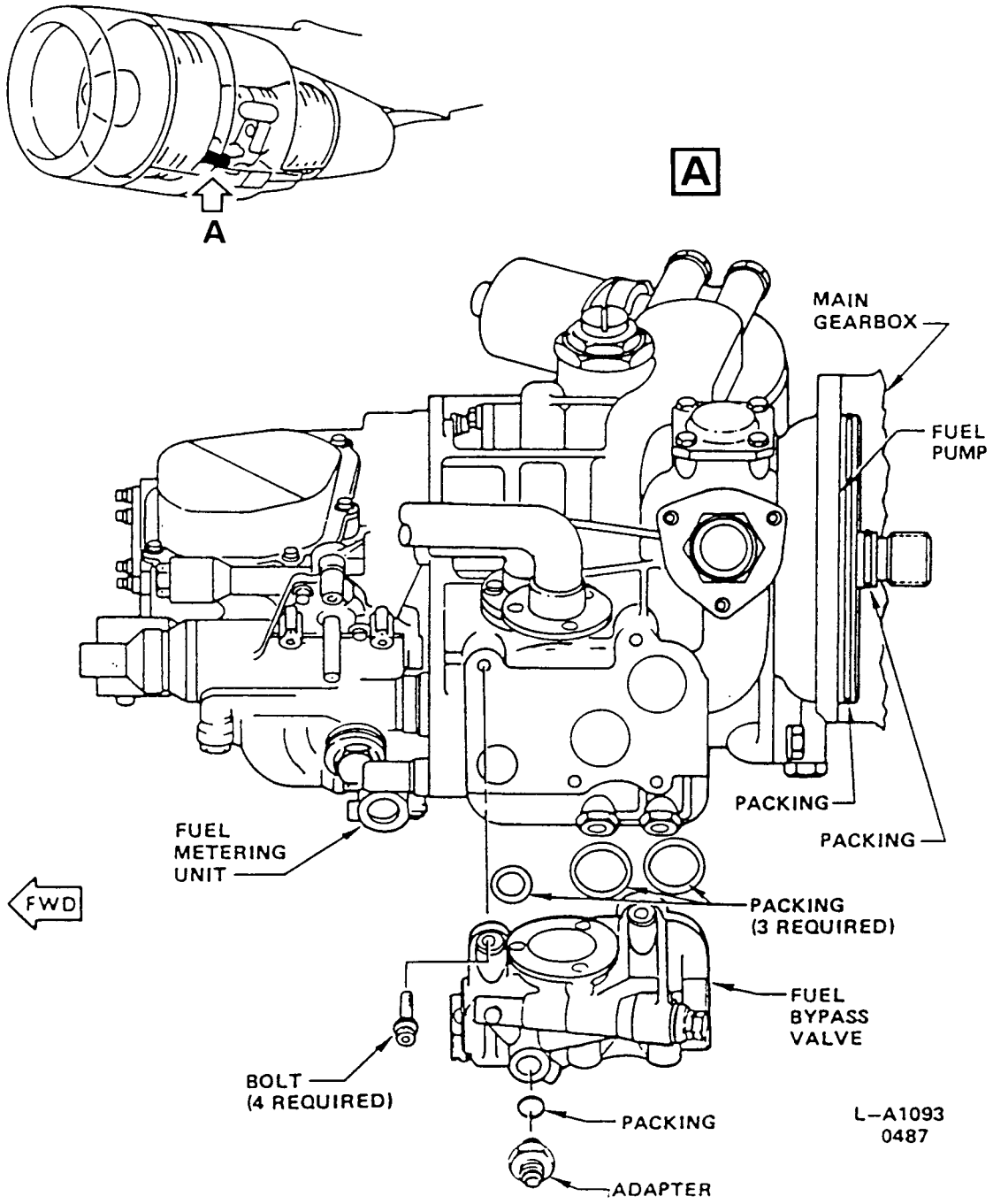
A. Job Set-Up
(1)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.
(2)Open, safety and tag the appropriate circuit breakers, and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)
(1)Drain residual fuel from fuel pump by removing lockwire and plug from base of pump forward and opposite side of fuel filter (gear discharge pressure port FP3). Discard packing.
NOTE : Be prepared to catch fuel in container with a minimum capacity of 5 US gallons (19 liters).
(2)Using new packing lubricated with Material No.P06-002, reinstall plug. TORQUE plug to between 45 and 55 lbf. in. (0.50 and 0.62 m.daN) and secure with lockwire.
(3)Remove lockwire and disconnect compressor stator cylinder manifold assembly from adapter on fuel bypass valve, fuel pump, and manifold tee. Remove manifold from engine.
(4)Remove bolts securing oil cooler inlet fuel tube assembly to top of fuel bypass valve.
(5)Remove bolts securing fuel bypass valve to fuel pump and remove valve from pump. Discard packings.
(6)Remove packing from flange of oil cooler inlet fuel tube assembly.
(7)If fuel bypass valve is to be replaced, comply with the following :
(a)Remove adapter from pressure port on fuel bypass valve and discard packing.
(8)Install protective covers.



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Fuel Bypass Valve (Sheet 1/2)
Figure 401



BM5 73 12 02 4 KAMS - 00

Fuel Bypass Valve (Sheet 2/2)
Figure 401

C. Installation (Ref. Fig. 401)
(1)Remove protective closures.
(2)If new fuel bypass valve is being installed comply with the following :
(a)Install packing lubricated with Material No.P06-002, to adapter and install adapter, threads lubricated with Material No.P03-001, to pressure port on fuel bypass valve. TORQUE adapter to between 110 and 120 lbf. in. (1.24 and 1.35 m.daN).
(3)Install packing lubricated with Material No.P06-002, to flange of oil cooler inlet fuel tube assembly.
(4)Install packings lubricated with Material No.P06-002, to recesses on pad on inboard side of fuel pump. Install fuel bypass valve to fuel pump aligning boltholes. Secure valve to pump with bolts, threads lubricated with Material No.P03-001. TORQUE bolts to between 85 and 95 lbf. in. (0.96 and 1.07 m.daN).
(5)Position flange of oil cooler inlet fuel tube assembly, to large opening on fuel bypass valve, (packing previously installed), and secure with bolts threads lubricated with Material No.P03-001. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).
(6)Lubricate threads of fuel bypass valve adapter with Material No.P03-001. Install compressor manifold assembly to fuel bypass valve, fuel pump, and pressure manifold tee. TORQUE manifold nut to bypass valve to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN). TORQUE manifold nut to fuel pump to between 200 and 225 lbf.in. (2.26 and 2.54 m.daN). TORQUE manifold nut to manifold tee to between 340 and 375 lbf.in. (3.84 and 4.24 N.m). Secure all nuts with lockwire.

D. Close-Up
(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

(2)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(3)Remove safety clips and tags and close previously opened circuit breakers.
(4)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

FUEL FILTER - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Filter Element
C.	Packings
D.	Corrosion Resistant Steel Lockwire (MS20995 or AS3214-02) (Ref. 70-00-00)
E.	Container, Approx. 5gal (19L)
F.	Torque Wrench
G.	Protective Covers
H. Material No.P03-001	Oils (Ref. 70-00-00)
I. Material No.P05-005	Special Material (Ref. 70-00-00)
J. Material No.P11-004	Cleaning Agents (Ref. 70-00-00)
K. Material No.P05-289	Special Materials (Ref. 70-00-00)
L. Material No.P05-291	Special Materials (Ref. 70-00-00)
M. Material No.P05-292	Special Materials (Ref. 70-00-00)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Door
R - 73-12-03, P. Block 601	Fuel Pump Filter

2. Procedure

A. Job Set-Up

(1)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(2)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(3)Open, safety and tag the appropriate circuit breakers and open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

WARNING : DO NOT LET ENGINE FUEL STAY ON YOUR SKIN FOR A LONG TIME. THE FUEL IS POISONOUS AND CAN GO THROUGH YOUR SKIN.
PUT A CONTAINER, MINIMUM CAPACITY OF 5 US GALLONS (19 LITERS), IN POSITION AND COLLECT THE DRAINED FUEL.

(1)Remove the lockwire and plug from the center of the fuel pump filter cover.
Let fuel drain. Discard the packing from the plug.

(2)For fuel pumps with the five cover bolts, washers, and no nuts (Pre SB PW4ENG 73-75), remove the filter as follows.

(a)Remove the bolts and washers. Monitor the torque necessary to remove (back-out) the bolt from each heli-coil self-locking feature. If the torque is less than 6.5 lbf.in. (0.07 m.daN), you must replace the heli-coil insert.

(b)Remove the cover and fuel filter.

NOTE : Some covers have machined slots in the split surface of the cover. These slots will help remove the cover.

(c)Discard the packing from the cover.

R (d)Examine the filter, the filter housing cavity, and the cover.

R 1 Make sure that the filter element gaskets are on the filter element and not stuck in the cavity or cover.

R 2 Look for bronze colored particles. If you find bronze particles (contamination), you must replace the fuel metering unit and the fuel pump (Ref. 73-12-03, P. Block 601).

(e)Install the protective covers.

(3)For fuel pumps with the four cover nuts, washers, dee-bolts, and the torque-limiting bolt (Post SB PW4ENG 73-75) and (Pre SB PW4ENG 73-104), remove the filter as follows.

CAUTION : WHEN YOU LOOSEN THE TORQUE LIMITING BOLT, DO NOT PUT UNWANTED FORCE ON THE BOLT HEAD.
KEEP THE WRENCH STRAIGHT AND AT 90 DEGREES TO THE BOLT HEAD AND LOOSEN THE BOLT SLOWLY. BOLT HEAD FAILURE CAN RESULT IF YOU DO NOT USE THESE INSTRUCTIONS.

(a)Keep the wrench straight and at 90 degrees to the bolt head and slowly loosen and remove the torque limiting bolt. Monitor the torque necessary to remove (back out) the bolt from the heli-coil self-locking feature. If this torque is less than 6.5 lbf.in. (0.07 m.daN), you must replace the heli-coil insert.

(b)Remove the nuts and washers.

(c)Remove the cover and fuel filter.

NOTE : Some covers have machined slots in the split surface of the cover. These slots will help remove the cover.

R (d)Examine the filter, the filter cavity, and the filter cover.

R 1 Make sure that the filter element gaskets are on the filter element and not stuck in the cavity or cover.

R 2 Look for bronze colored particles. If you find bronze particles (contamination), you must replace the fuel metering unit and the fuel pump (Ref. 73-12-03, P. Block 601).

(e)Discard the packing from the cover.

(f)Install the protective covers.

(4)For fuel pumps with the five nuts, washers, and the four dee-bolts (Post SB PW4ENG 73-104), remove the filter as follows.

(a)Remove the nuts, washers.

(b)Remove the cover and fuel filter.

NOTE : Covers have machined slots in the split surface of the cover. These slots will help remove the cover.

R (c)Examine the filter, the filter housing cavity, and the cover.

R 1 Make sure that the filter element gaskets are on the filter element and not stuck in the cavity or cover.

R 2 Look for bronze colored particles. If you find bronze particles (contamination), you must replace the fuel metering unit and the fuel pump (Ref. 73-12-03, P. Block 601).

(d)Discard the packing from the cover.

(e)Install the protection covers.

C. Installation (Ref. Fig. 401)

CAUTION : REPLACE THE USED FUEL FILTER ELEMENT WITH A NEW FUEL FILTER ELEMENT.
DO NOT CLEAN OR USE THE SAME FUEL FILTER ELEMENT AGAIN.
INSTALL THE CORRECT FUEL FILTER ELEMENT FOR THE ENGINE MODEL.
LOOK AT THE ELEMENT TO FIND THE PART NUMBER AND ENGINE MODEL MARKS. IF THE ELEMENT IS INCORRECT FOR THE ENGINE MODEL, THIS CAN CAUSE CONTAMINATION OF THE FUEL SYSTEM AND UNSATISFACTORY ENGINE OPERATION.

(1)Remove the protective covers and wipe cover and filter cavity using lint free cotton cloth, Material No.P05-005. Inspect the heli-coil insert(s). If the insert(s) are not recessed in the housing, the pump should be replaced.

CAUTION : IT IS POSSIBLE THAT THE OLD GASKETS FROM THE REMOVED FILTER ELEMENT CAN BE STUCK INSIDE THE FILTER CAVITY OR COVER. BE SURE YOU EXAMINE THE FILTER CAVITY AND COVER. REMOVE THE OLD FILTER GASKETS FROM THE CAVITY AND COVER IF NECESSARY OR ENGINE DAMAGE CAN RESULT.

(2)Examine the filter cavity and cover. Be sure that the old gaskets from the removed filter element are not stuck in the cavity or cover. Remove the old gaskets if necessary.

(3)Install packing lubricated with engine oil, Material No.P03-001, to groove in cover.

CAUTION : YOU MUST ADHERE (KEEP) TO THE FOLLOWING TORQUING PROCEDURE TO PREVENT DAMAGE TO THE PACKING AND HELI-COIL INSERTS, AND THE FILTER COVER FROM COCKING (NOT ALIGNED)

(4)For fuel pumps with the five cover bolts, washers, and no nuts (Pre SB PW4ENG 73-75), install the filter as follows.

CAUTION : MAKE CERTAIN THAT THE COVER BOLTS ARE EVENLY TIGHTENED.
MONITOR THE COVER INSTALLATION AND MAKE CERTAIN THE COVER ENGAGES THE HOUSING EVENLY AND FREELY. DO NOT OVERTORQUE THE BOLTS.

(a)Do not use any lubricant on the threads of bolts.
Clean the threads of the bolts with Material No. P11-004 and dry before installation of bolts. Install the new filter element onto the fuel pump filter cover and install to fuel pump. Attach with bolts (dry), and washers.
Engage evenly the filter cover by tightening evenly the bolts, and monitor the "run on" torque required to turn each bolt through the inserts before the last torque. TORQUE the bolts to between 150 AND 170 lbf. in. (1.69 and 1.92 m.daN) plus the torque required to turn the bolts through the heli-coil inserts.
If you must replace the heli-coil inserts, but the inserts are not available, you can use alternate bolts (and lockwire). Tighten the filter cover by tightening the alternate bolts using the above torquing procedure. Wirelock the bolts using lockwire, Material No.P05-289 or safety cable, Material No.P05-291 and safety cable ferrule, Material No.P05-292 to safety the bolts.

(5)For fuel pumps with the four nuts, washers, dee-bolts, and the torque-

limiting bolt (Post SB PW4ENG 73-75) and (Pre SB PW4ENG 73-104), install the filter as follows.

CAUTION : MAKE CERTAIN THE COVER NUTS ARE EVENLY TIGHTENED. DO NOT USE THE TORQUE LIMITING BOLT TO ENGAGE THE COVER TO THE HOUSING. MONITOR THE COVER INSTALLATION AND MAKE CERTAIN THE COVER ENGAGES THE HOUSING EVENLY AND FREELY. DO NOT OVERTORQUE THE NUTS OR BOLT.

(a)Do not use any lubricant on the threads of bolts.
It is recommended to clean threads of the bolts with Material No. P11-004 and to dry before installation of bolts. Install the new filter element onto the fuel pump filter cover and install to fuel pump. Attach with four washers and nuts. Install the torque-limiting bolt and washer. Do not use the torque-limiting bolt to engage the cover to the pump. Engage evenly the filter cover by tightening evenly the nuts.
Monitor the "Run On" torque needed to turn the nuts through the self locking feature. After the cover is completely engaged, loosen and TORQUE the four nuts (one at time) to between 150 and 170 lbf. in. (1.69 and 1.92 m.daN) plus the "Run-On" torque. TORQUE the torque-limiting bolt to between 150 and 170 lbf.in. (1.69 and 1.92 m.daN) plus the "Run On" torque.

(End SB PW4 ENG 73-75)

(6)For fuel pumps with the five nuts, washers, and the four dee-bolts (Post SB PW4ENG 73-104), install the filter as follows.

CAUTION : BE SURE YOU TIGHTEN THE COVER NUTS EVENLY TO ENGAGE THE COVER TO THE HOUSING.
MONITOR THE COVER INSTALLATION AND BE SURE THE COVER ENGAGES THE HOUSING EVENLY AND FREELY. DO NOT OVERTORQUE THE NUTS.

(a)Do not use any lubricant on the threads of bolts.
Clean the threads of the bolts with Material No.P11-004 and dry before installation of bolts. Install the new filter element on to the fuel pump filter cover and install to fuel pump.
Attach with the five washers and nuts. Engage evenly the filter cover by tightening evenly the nuts. Monitor the "Run-On" torque needed to turn the nuts through the locking feature.
After the cover is completely engaged, loosen and TORQUE the five nuts (one at a time) to between 150 and 170 lbf.in. (1.69 and 1.92 m.daN) plus the Run-On Torque.

(End SB PW4 ENG 73-104)

(7)Install packing lubricated with engine oil, Material No.P03-001, to plug. Lubricate thread of plug with Material No.P03-001 and install plug to center opening on filter cover. TORQUE plug to between 45 and 55 lbf. in. (0.51 and 0.62 m.daN). Wirelock plug using lockwire, Material No.P05-289 or safety cable, Material No.P05-291 and safety cable ferrule, Material No.P05-292 to safety the plug.

D. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

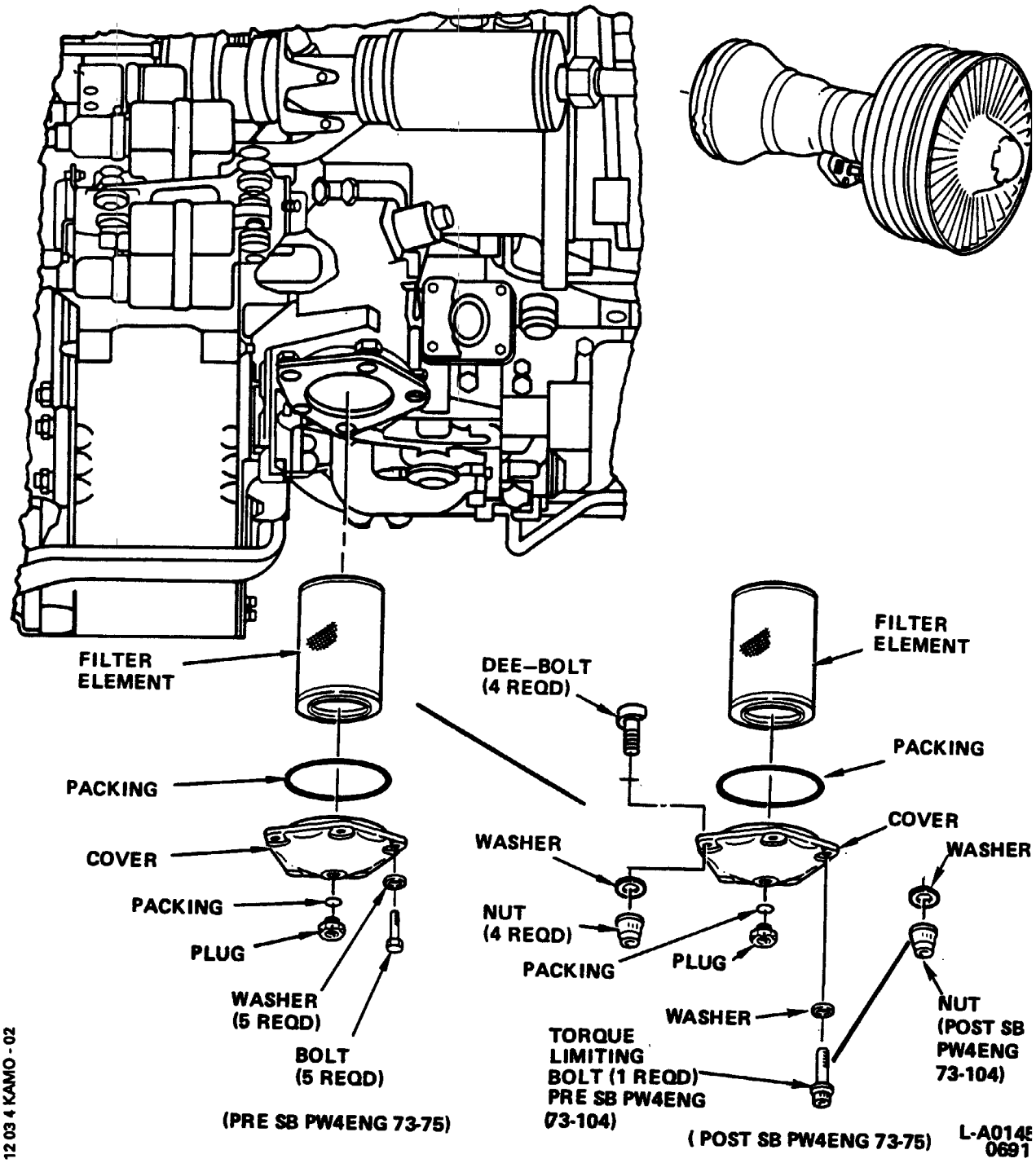
(2)Close thrust reverser and fan cowl doors, and remove

safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

(3) On the appropriate FIRE control module, push the fire handle, and remove the warning notice.

(4) Test engine per test reference table (Ref. 71-00-00, P. Block 501).

(5) De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).



Fuel Pump Filter
Figure 401

FUEL FILTER - INSPECTION/CHECK

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
Referenced Procedures	
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-03, P. Block 401	Fuel Filter
- 73-13-05, P. Block 601	Fuel Distribution Valve

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the appropriate circuit breakers and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(2)Remove fuel filter (Ref. 73-12-03, P. Block 401)

B. Inspection/Check
(1)Remove the perforated aluminum sheet or the stainless steel mesh wrap from around the filter to examine the pleated paper element.
(2)Examine the paper element for signs of damage or for a collection of contamination.
R (a)Look for bronze colored particles. If you find bronze particles
R (contamination), you must replace the fuel metering unit and fuel
R pump.
R NOTE : Bronze particles are very fine and can collect into larger
R particles. It is possible for bronze particles to collect at
R the bottom of the filter pleat, which an inspector can think
R is a manufactured bronze braze/weld. The fuel pump filter must
R get full inspection. Look carefully at the pleat base for
R bronze particles or indication of bronze discoloration.
(3)Replace the used filter element with a new filter element.
NOTE : Do NOT clean the filter element.
Do NOT use the same filter element again.

C. Close-Up
(1)Install fuel filter (Ref. 73-12-03, P. Block 401).
(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment
(3)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301). Remove safety clips and tags and close circuit breakers.

MAIN FUEL SUPPLY LINE - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Container, Approx. 10 Gal. (37.85 l)
C.	Gaskets
D.	Torque Wrench
E. Material No.P05-262	Special Materials (Ref. 70-00-00)
F. Material No.P05-289	Special Materials (Ref. 70-00-00)
G. Material No.P05-291	Special Materials (Ref. 70-00-00)
H. Material No.P05-292	Special Materials (Ref. 70-00-00)
Referenced Procedures	
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant - General

2. Procedure

A. Job Set-Up
(1) On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.
(2) Open, safety and tag the appropriate circuit breakers and open the fan cowl and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

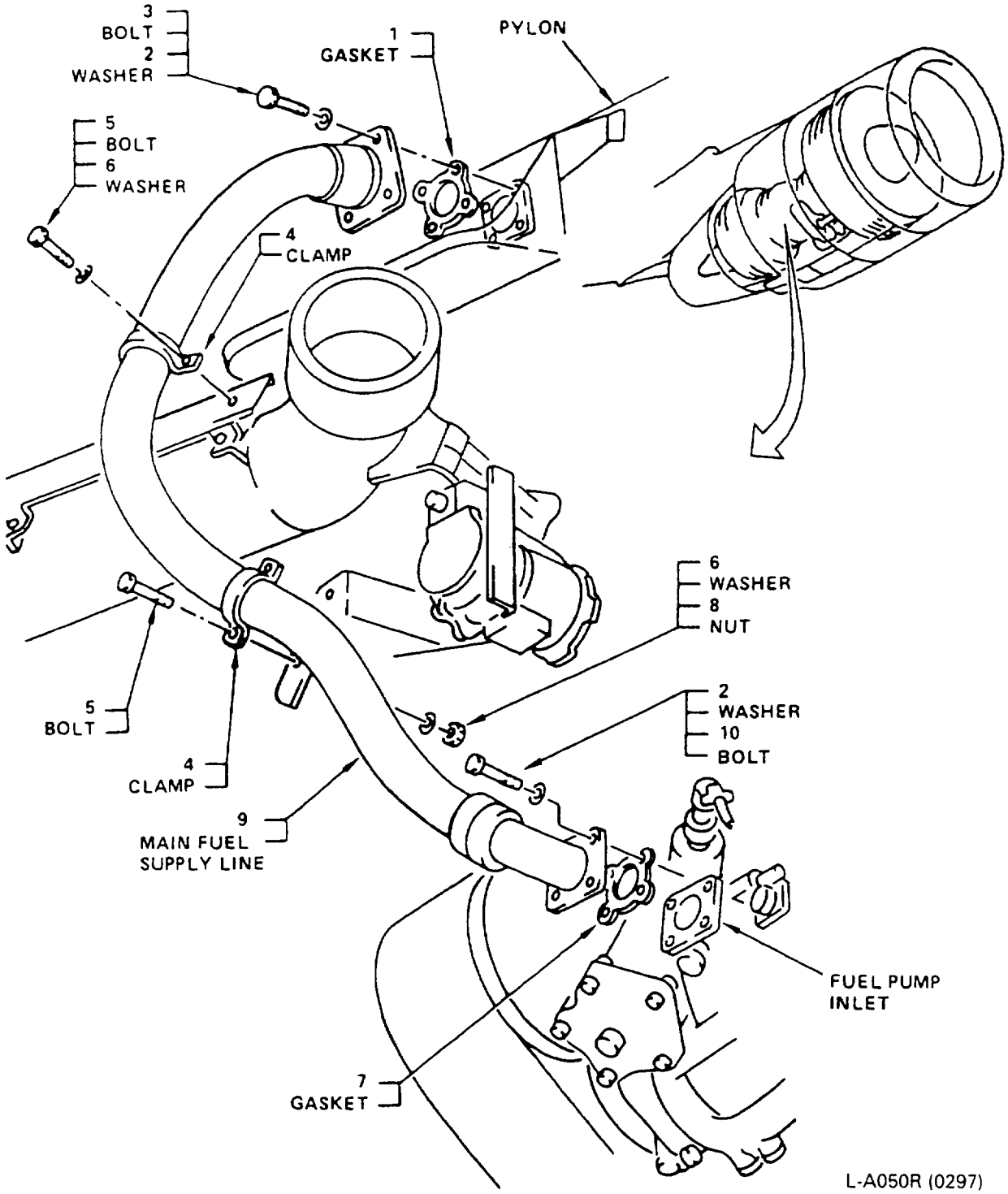
B. Removal (Ref. Fig. 401)
(1) Position container under main fuel supply line at fuel pump inlet.
(2) Remove bolts and washers from inlet flange. Remove fuel supply line and discard gasket. Allow all fuel to drain from line.
(3) Remove bolts, washers, and nuts attaching clamps and remove clamps.
(4) Remove lockwire, bolts and washers attaching line to pylon. Remove and discard gasket.
(5) Remove line from engine, and install protective covers on line and all open ports.

C. Installation (Ref. Fig. 401)
CAUTION : DO NOT EXCEED 12.5 IN. (317.5 MM) MINIMUM BEND RADIUS ON MAIN FUEL HOSE DURING INSTALLATION. TEFLON FUEL HOSES HAVE MINIMUM BEND RADIUS OF 10.0 IN. (254.0 MM). FAILURE TO COMPLY MAY RESULT IN SERIOUS DAMAGE TO FUEL HOSE AND CREATE FLIGHT SAFETY HAZARD.
(1) Position engine main fuel supply line (9) between fuel pump inlet and port on pylon. Remove protective covers from line and ports.
(2) Install clamps (4) loosely on fuel line with bolts (5), washers (6), and nuts (8).
(3) Install gasket (7) and lower end of main fuel supply line (9) on pump inlet with bolts (10) and washers (2). TORQUE the bolts to between 180 and 200 lbf.in. (2.04 and 2.25 m.daN). Safety the bolts with Lockwire (Material No.P05-262), Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(4)Install gasket (1) and upper end of main fuel supply line (9) on pylon with bolts (3) and washers (2). TORQUE to between 126 and 140 lbf.in. (1.43 and 1.58 m.daN). Safety the bolts with Lockwire (Material No.P05-262), Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).
(5)TORQUE bolts on upper clamp to between 63 and 70 lbf.in. (0.72 and 0.79 m.daN) and nuts on lower clamp to between 50 and 70 lbf.in. (0.57 and 0.79 m.daN).

D. Test
(1)Perform leak test at idle power (Ref. 71-00-00, P. Block 501 - Test No. 3).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close fan cowl and thrust reverser doors (Ref. 71-13-00, P. Block 301). Remove safety clips and tags and close circuit breakers.
(3)On the appropriate FIRE control module, push the fire handle and remove the warning notice.



BM5 73 12 04 4 KAM0 01

Main Fuel Supply Line
Figure 401

MAIN FUEL SUPPLY LINE - INSPECTION/CHECK

1. General

This procedure provides instructions to inspect the identification band of all main fuel supply hoses.
Certain main fuel supply hoses installed on aircraft were manufactured with an inner rubber liner which may exhibit premature degradation as a result of leakage.

2. Equipment and Materials

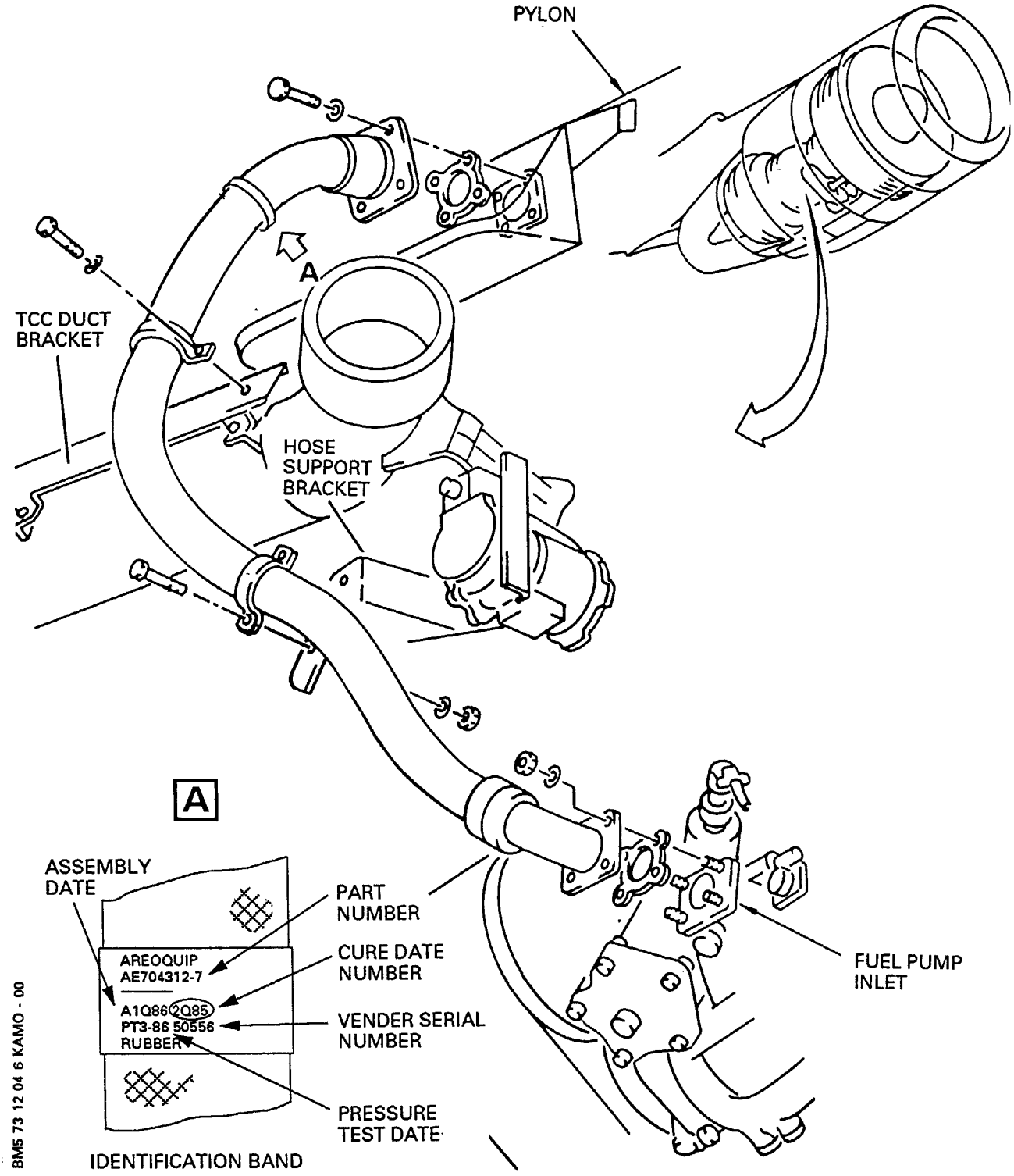
ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Access Platform
Referenced Procedures	
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-04, P. Block 401	Main Fuel Supply Line

3. Procedure

A. Job Set-Up
(1) Open, safety and tag the appropriate circuit breakers and open right fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(2) Install access platform.

B. Inspection/Check
(1) Locate main fuel supply hose on right side of the engine core (Ref. Fig. 601).
(2) Inspect identification band on hose to determine vendor cure date. If hose is identified with cure dates other than 3Q84 through 2Q87 hose assembly is acceptable. If hose is identified with cure dates 3Q84 through 2Q87, remove and replace with serviceable hoses (Ref. 73-12-04, P. Block 301).
(3) Return for inspection all hoses exhibiting a vendor cure date within the range of 3Q84 through 2Q87.
NOTE : If the supplier inspection confirms the integrity of the hose inner rubber liner, a re-certification band will be added to the hose. The data on the re-certification band will include : the term "Recertified", Vendor Code 06827, the location code of the Aeroquip facility performing the re-certification, and month/year of re-certification.

C. Close-Up
(1) Note in engine log book and/or other applicable records the information that Service Bulletin PW4 NAC A73-4 Revision No. 1 has been incorporated.
(2) Remove access platform.
(3) Remove safety clips and tags and close circuit breakers.
Close fan and thrust reverser cowls doors (Ref. 71-13-00, P. Block 301).



Identification Band of Main Fuel Supply Hose
Figure 601

FUEL/OIL COOLER RETURN HOSE AND TUBE - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protection Covers
C.	Packings
D.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
E.	Retainer
F.	Torque Wrench
G.	Key Washer
H.	Warning Notice
J. Material No.P03-001	Oils (Ref. 70-00-00)
K. Material No.P05-289	Special Materials (Ref. 70-00-00)
L. Material No.P05-291	Special Materials (Ref. 70-00-00)
M. Material No.P05-292	Special Materials (Ref. 70-00-00)
R N. Material No.P06-054	Lubricants (Ref. 70-00-00)
P. Material No.P06-021	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-01, P. Block 401	Pump - Fuel
- 79-23-04, P. Block 401	Breather and Restrictor Valve - No. 3 Bearing

2. Procedure

A. Job Set-Up

(1) On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(2) Open, safety and tag the appropriate circuit breakers and open the fan cowl and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

(3) Remove fuel pump and fuel metering unit (package) (Ref. 73-12-01, P. Block 401).

(4) Remove the No. 3 bearing breather and restrictor valve (Ref. 79-23-04, P. Block 401).

B. Remove the Fuel/Oil Cooler Return Tube (FM11)
(Ref. Fig. 401, 402, 403)
(Ref. Fig. 404)

(1) Disconnect the fuel pump inlet tube (FM11) from the aft end of the fuel/oil cooler.

(2) Remove the AP-5 borescope plug as follows :

(a) Find the AP-5 borescope plug on the HPC case at approximately the 7 o'clock position.

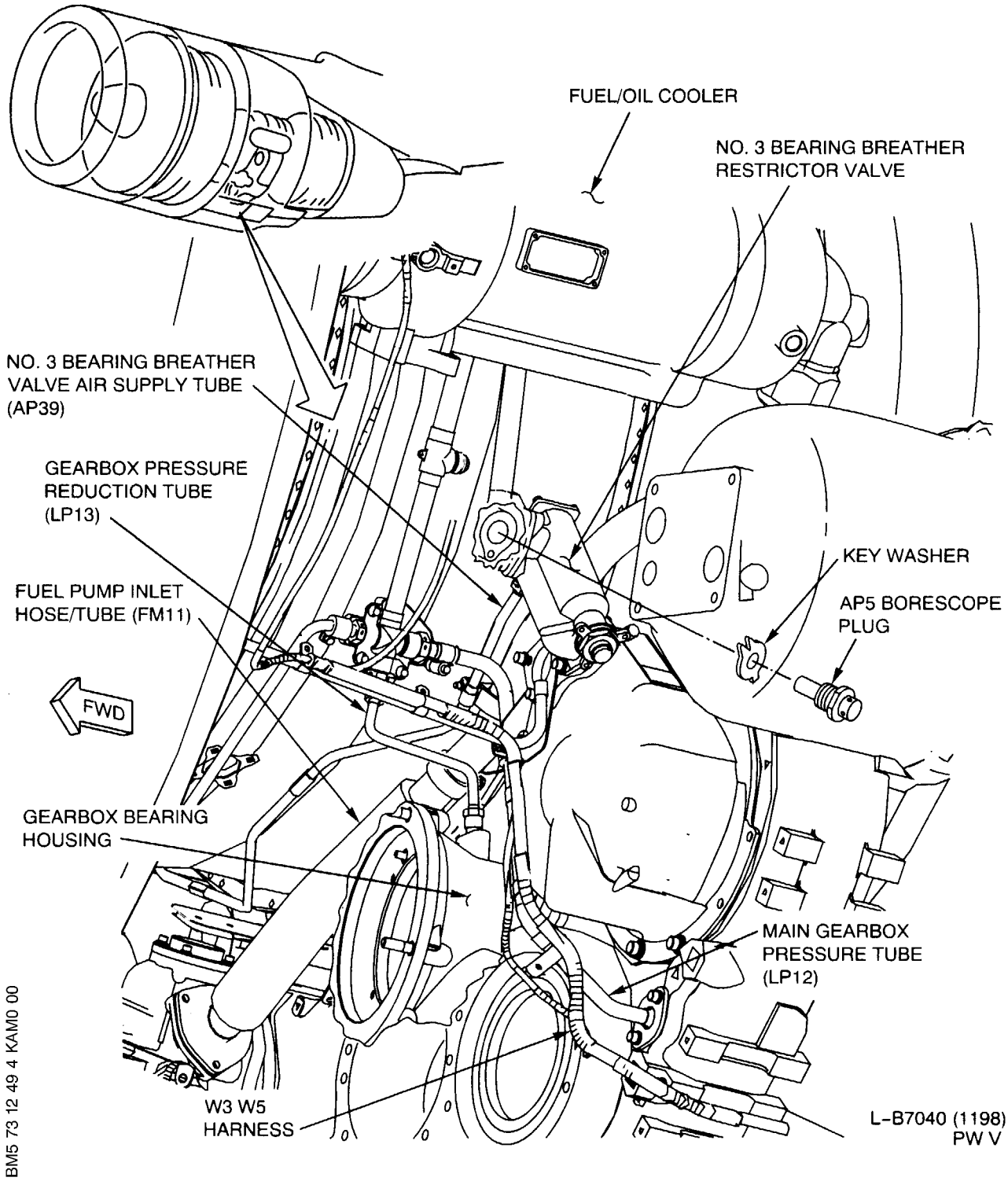
(b) Remove the AP-5 plug and key washer from the HPC case.

(3) Remove the heatshield and clamp from the (LP08) tee as follows :

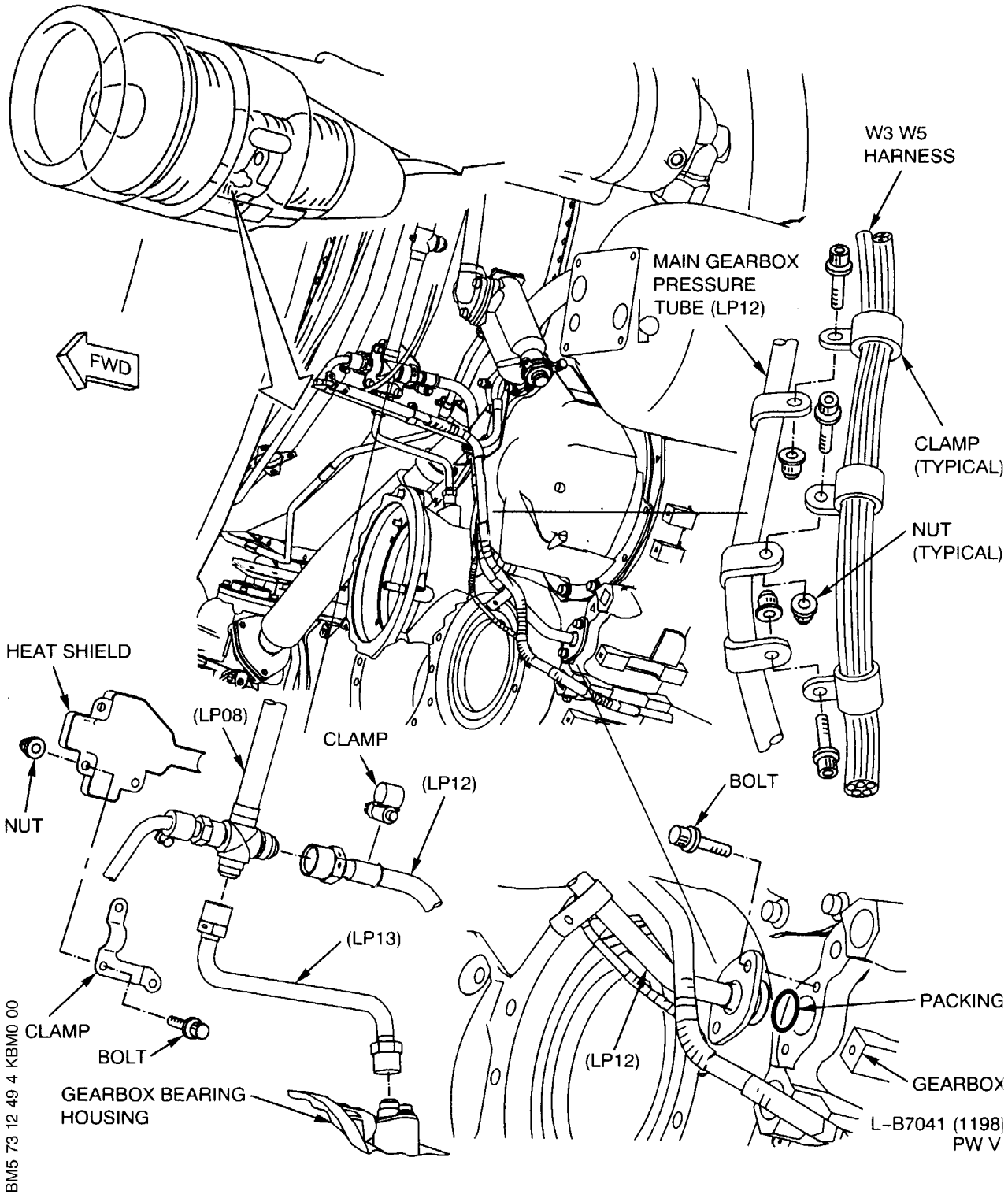
(a) Remove the three bolts and nuts which attach the heatshield and

clamp to the (LP08) tee.
(b)Remove the clamp which attaches the heatshield to (LP12).
(c)Remove the heatshield and clamp from the engine.
(4)Remove the main gearbox pressure tube (LP12) as follows :
(a)Disconnect the (LP12) from the (LP08) tee.
(b)Remove the two bolts which attach the (LP12) tube flange to the gear box.
(c)Remove the clamp bolts and nuts which attach the (LP12) tube to the W3 and W5 harness clamps.
(d)Remove the clamp bolt which attaches the (LP12) tube to the bracket below the (FM11) tube.
(e)Remove the (LP12) tube from the engine.
(5)Remove the gearbox pressure tube (LP13) from the (LP08) and the gearbox as follows :
(a)Disconnect the (LP13) tube from the gearbox bearing housing.
(b)Disconnect the (LP13) tube from the (LP08) tee.
(c)Remove the (LP13) tube from the engine.
(6)Disconnect the clamps on the (FM11) tube.
(a)Remove the bolts and nuts which attach the clamps to (AP39) and the bracket.
(7)Remove the (FM11) tube from the engine.
(a)With fuel pump and FMU removed, hold the flanged end of the (FM11) tube and carefully remove the (FM11) tube from the right side of the engine.
(b)Remove the retainer and packing from the (fuel/oil cooler end) on the (FM11) tube.
(8)Install protection covers to all openings.

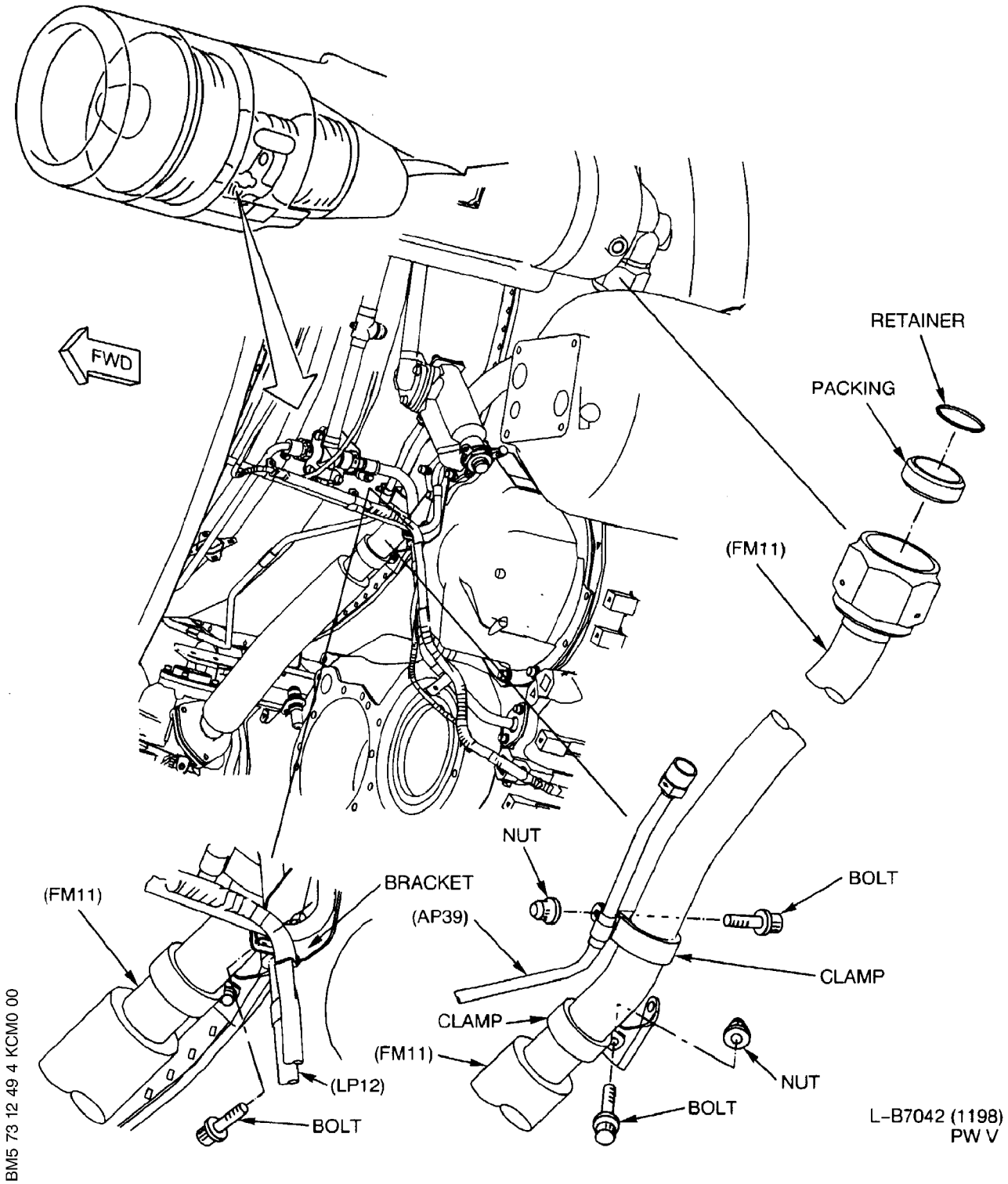
C. Install the Fuel/Oil Cooler Return Tube (FM11)
(Ref. Fig. 401, 402, 403)
(Ref. Fig. 404)
(1)Remove the protection covers from the openings.
(2)Install the fuel pump inlet tube (FM11) as follows :
(a)(From the right side of the engine) Put the (FM11) tube in position below the HPC.
(b)Move the (FM11) tube around the HPC on the left side of the engine until the top end of the tube is in position on aft port of the fuel/oil cooler.
(c)Lubricate the packing and retainer with Engine Oil (Material No.P03-001).
(d)Lubricate the adapter on the fuel/oil cooler (aft port) with Antigalling Compound (Material No.P06-021).
(e)Attach the (FM11) to the aft port of the fuel/oil cooler, hand tight only.
(f)Attach the two clamps on the (FM11) tube.
1 Lubricate the two clamp bolts with Engine Oil (Material No.P03-001).
2 Install the bolt and nut to the (FM11) clamp and the (AP39) clamp, hand tight only.
3 Install the bolt and nut the (FM11) clamp and bracket, hand tight only.
(3)Install the fuel pump and fuel metering unit (package)


FUEL/OIL COOLER
NO. 3 BEARING BREATHER RESTRICTOR VALVE
NO. 3 BEARING BREATHER VALVE AIR SUPPLY TUBE (AP39)
GEARBOX PRESSURE REDUCTION TUBE (LP13)
FUEL PUMP INLET HOSE/TUBE (FM11)
KEY WASHER
AP5 BORESCOPE PLUG
FWD
GEARBOX BEARING HOUSING
MAIN GEARBOX PRESSURE TUBE (LP12)
W3 W5 HARNESS
L-B7040 (1198) PW V
BM5 73 12 49 4 KAM0 00

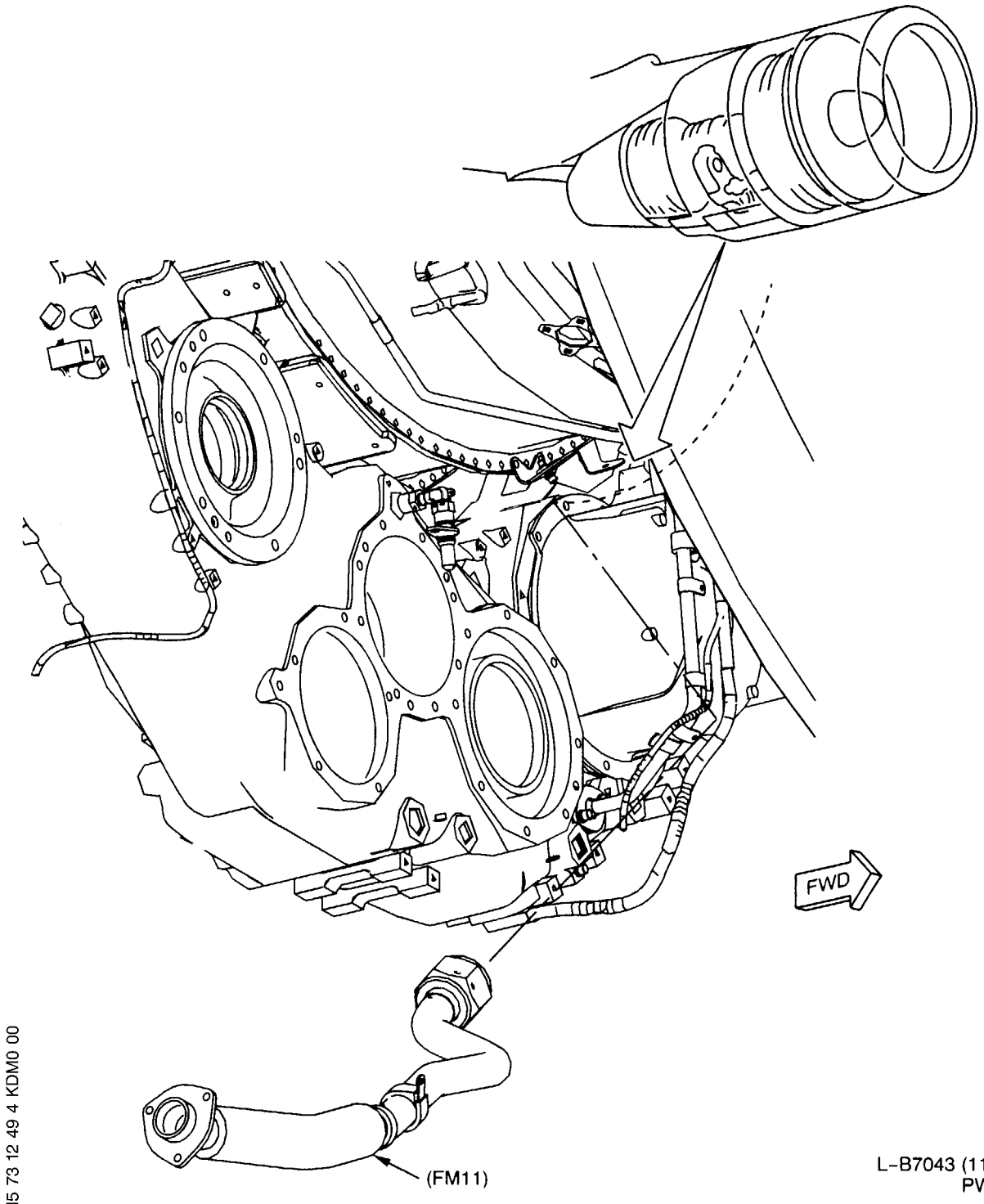
Fuel Pump Inlet Tube (FM11)
Figure 401



Fuel Pump Inlet Tube (FM11)
Figure 402



Fuel Pump Inlet Tube (FM11)
Figure 403



BM5 73 12 49 4 KDM0 00

L-B7043 (1198)
PW V

Removal/Installation of (FM11) from the Right Side
Figure 404

(Ref. 73-12-01, P. Block 401).

NOTE : The lower end of (FM11) is connected when you install the fuel pump and fuel metering unit (package).

(4)Complete the installation of the (FM11) tube as follows :

(a)TORQUE the two clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(b)TORQUE the (FM11) tube to between 150 and 160 lbf.in. (1.70 and
R 1.80 m.daN), then loosen to less than 10 lbf.in. (0.11 m.daN) and torque again to the same value.

(c)Safety the tube nut (FM11) with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(5)Install the main gearbox pressure tube (LP12) as follows :

(a)Lubricate the clamp bolt and harness clamp bolts with Engine Oil (Material No.P03-001).

(b)Lubricate the nut threads of (LP12) with Antigalling Compound (Material No.P06-021).

(c)Install the clamp on the upper end of (LP12).

(d)Lubricate the packing for the groove end of (LP12) with Engine Oil (Material No.P03-001).

(e)Install the packing to the groove on (LP12).

(f)Attach the (LP12) tube to the (LP08) tee , hand tight only.

(g)Install the clamp bolt to the clamp and the bracket hand tight only.

(h)Lubricate the two (LP12) flange bolts with Engine Oil (Material No.P03-001).

R (j)Install the two bolts to the (LP12) tube flange.

R (k)TORQUE the two flange bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

R (l)Attach the W3 and W5 harness clamp bolts and nuts to the (LP12).

R (m)TORQUE the clamp bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

R (n)TORQUE all the harness clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

R (p)TORQUE the (LP12) tube to (LP08) tee to between 340 and 375 lbf.in. (3.85 and 4.23 m.daN).

R (q)Safety the tube nut (LP12) with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(6)Install the gearbox pressure reduction tube (LP13) to the (LP08) tee and the gearbox bearing housing as follows :

(a)Lubricate the (LP13) tube nuts with Antigalling Compound (Material No.P06-021).

(b)Install the (LP13) tube to the (LP08) and the gearbox bearing housing, hand tight only.

(c)TORQUE the (LP13) tube nuts to between 200 and 225 lbf.in. (2.26 and 2.54 m.daN).

(d)Safety the tube nuts (LP13) with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(7)Install the heatshield to the (LP08) tube tee as follows :

(a)Lubricate the three heatshield bolts with Engine Oil (Material

No.P03-001).
(b)Install the heatshield and clamp to the (LP08) tee with the three bolts and nuts.
(c)TORQUE the three bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(d)TORQUE the clamp on (LP12) to the heatshield to between 18 and 23 lbf.in. (0.21 and 0.25 m.daN).
(e)Safety the three heatshield bolts with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).
(8)Install the AP-5 borescope plug to the HPC.
(a)Lubricate the threads of AP-5 with Antiseize Compound (Material No.P06-054).
(b)Install the new key washer and the plug to the AP-5 port.
(c)TORQUE the AP-5 plug to between 175 and 190 lbf.in. (1.98 and 2.14 m.daN).

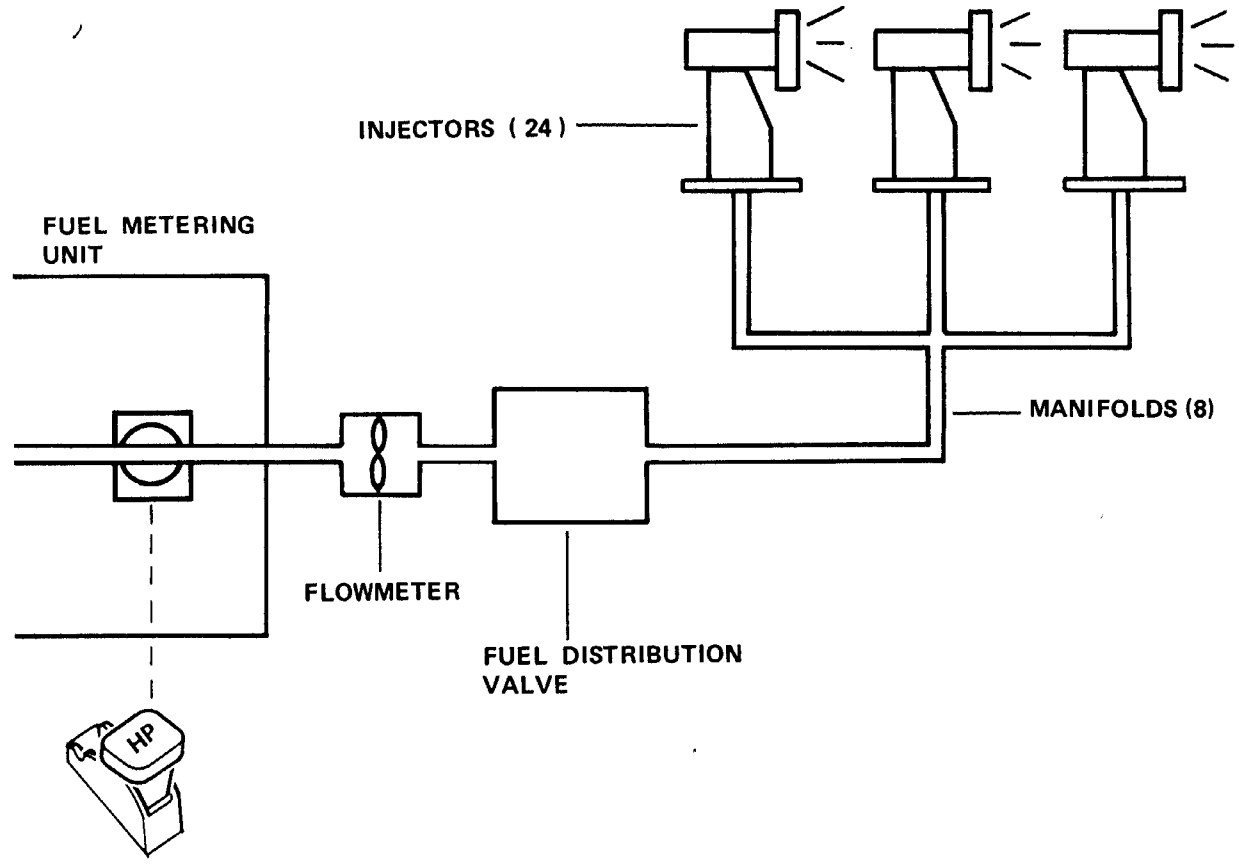
D. Close-Up
(1)Install the No. 3 bearing breather and restrictor valve (Ref. 79-23-04, P. Block 401).
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close fan cowl and thrust reverser doors (Ref. 71-13-00, P. Block 301). Remove safety clips and tags and close circuit breakers.
(3)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(4)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

VALVING - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 001)
   Combustion fuel from the fuel metering unit passes through the flowmeter, then distribution valve to the fuel injectors.

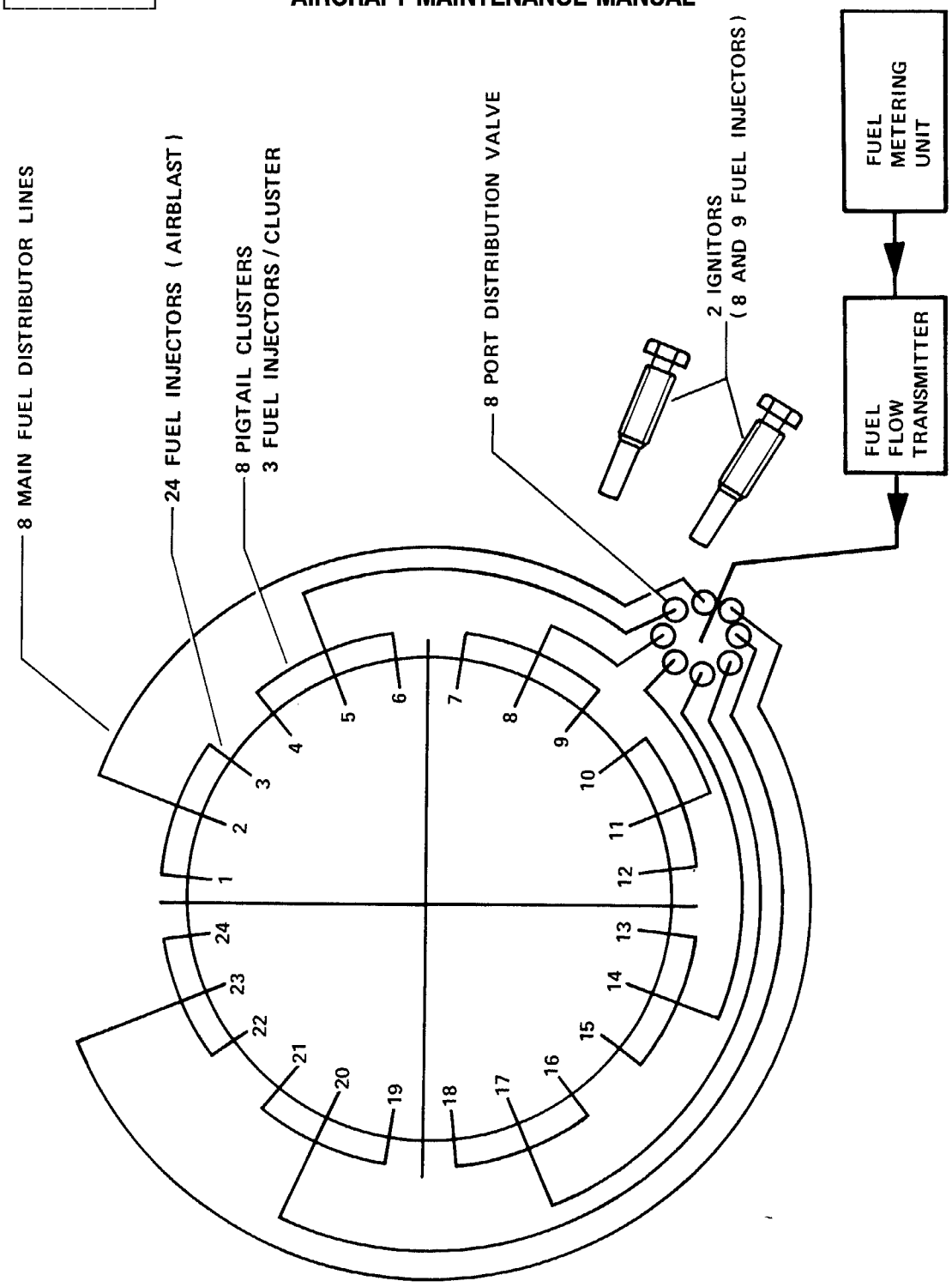
2. Fuel Distribution Valve (Ref. Fig. 002, 003, 004)
   The fuel distribution valve (FDV) subdivides scheduled engine fuel flow from the fuel metering unit equally to eight fuel manifolds, each of which in turn feed three fuel injectors.
   The FDV is bracket mounted to the engine HPC rear case assembly (Flanges J and K) at the 4 o'clock position. It includes provisions for draining 6 fuel manifolds when the engine is shut down. The two fuel manifolds which remain full provide faster engine starts by minimizing fuel manifold fill time. The FDV is sized to handle from 450 to 24,000 pph (204 to 10.886 kg/hour) and is equally divided among eight outlet ports. A self-relieving 200 mesh fuel strainer is incorporated in the FDV inlet passage.

3. Fuel Injectors (Ref. Fig. 005, 006)
   The fuel injectors are single-orifice, moderate fuel pressure drop aerating fuel nozzles which utilize air velocity to accomplish fuel atomization. Each injector will flow from 15 -1000 pph (7 - 454 kg/hour) of fuel with a 70 degree spray cone angle. An inlet screen and orifice (sized during injector bench calibration) are separately removable from the inlet fitting at the base of the injector support.
   There are twenty-four single orifice fuel injectors manifolded together in groups of three. Injectors are externally installed through ports in the diffuser case and bolted to cast mounting pads on the exterior of the case.



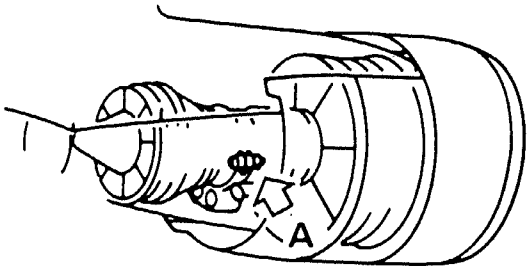
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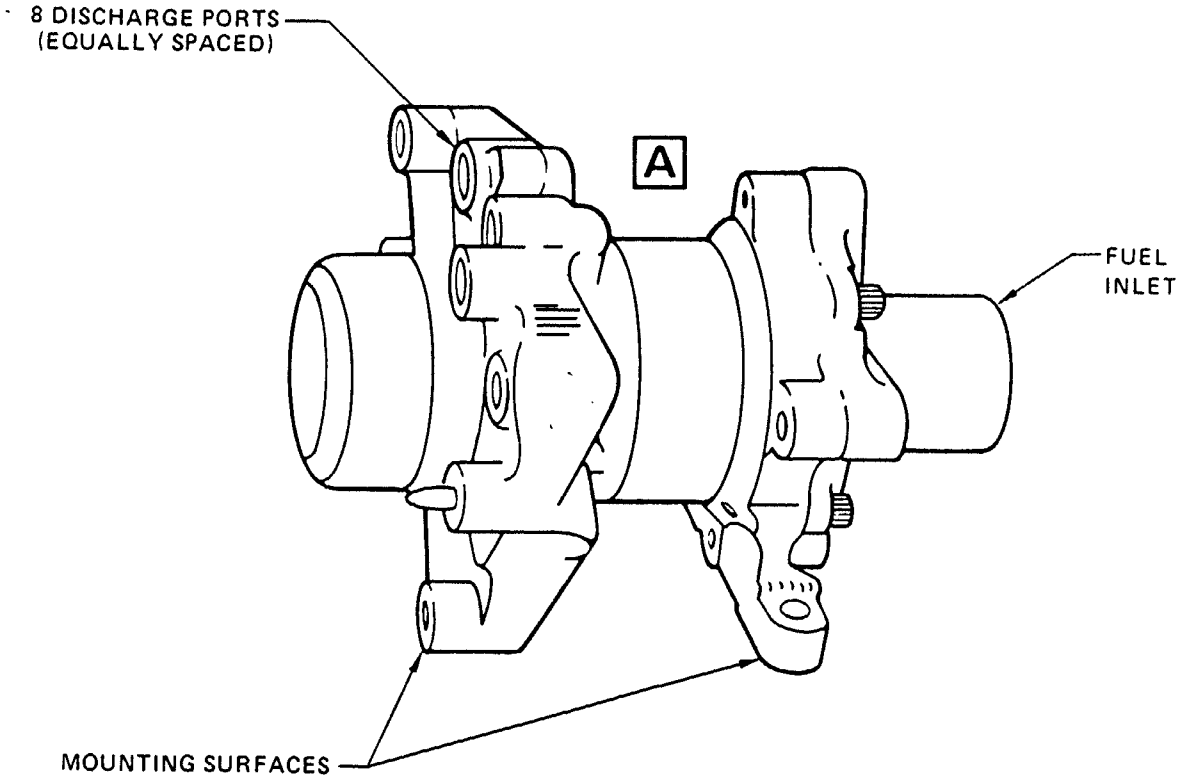
Fuel Feed
Figure 001



BM5 73 13 00 0 KCMO-19

Engine Fuel Feed Schematic
Figure 002

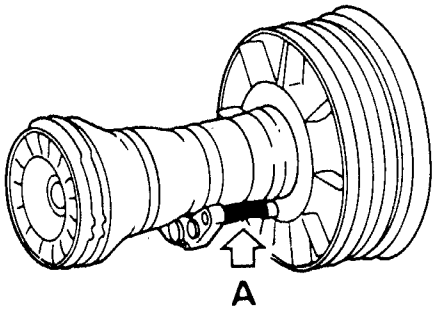


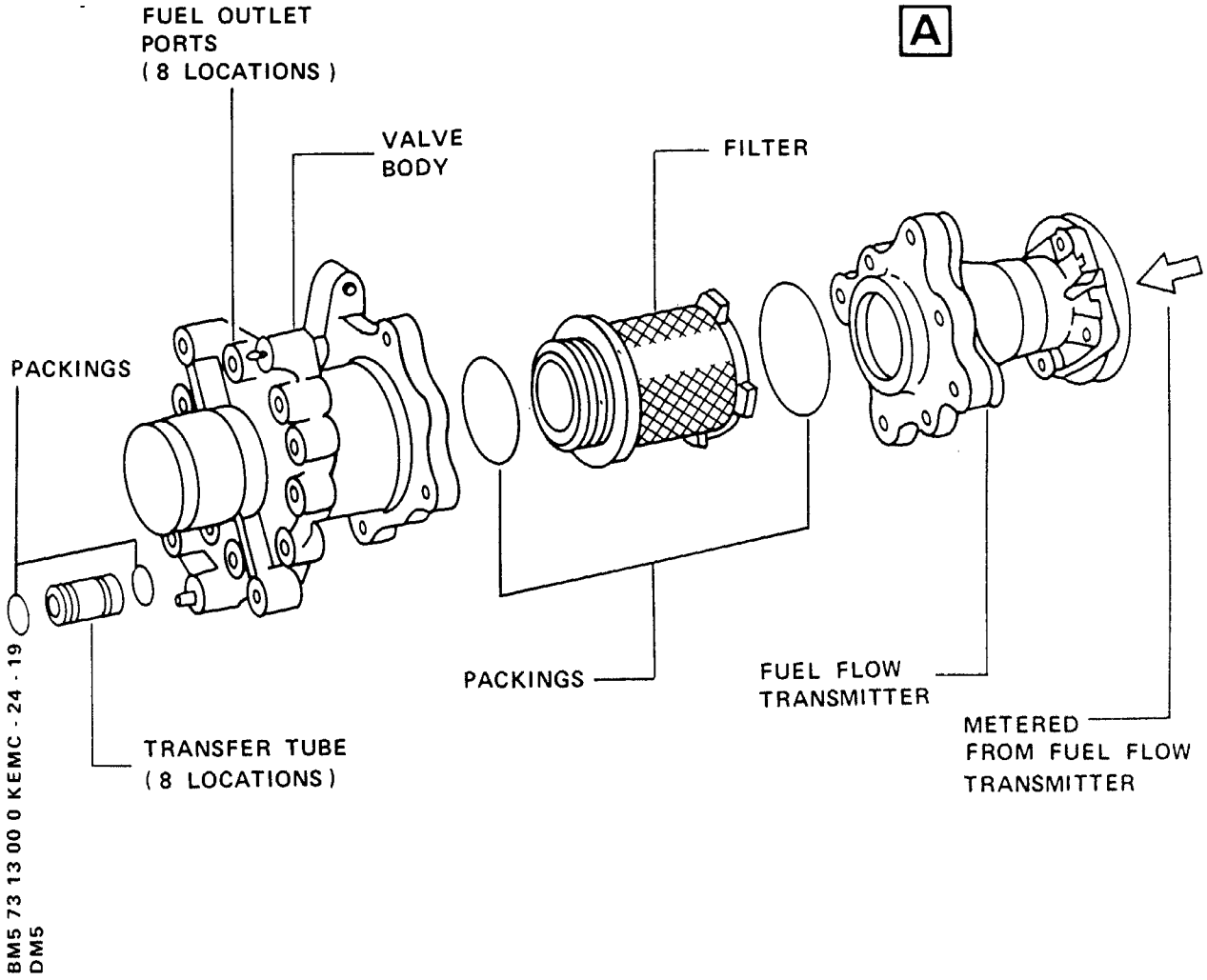


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DM5

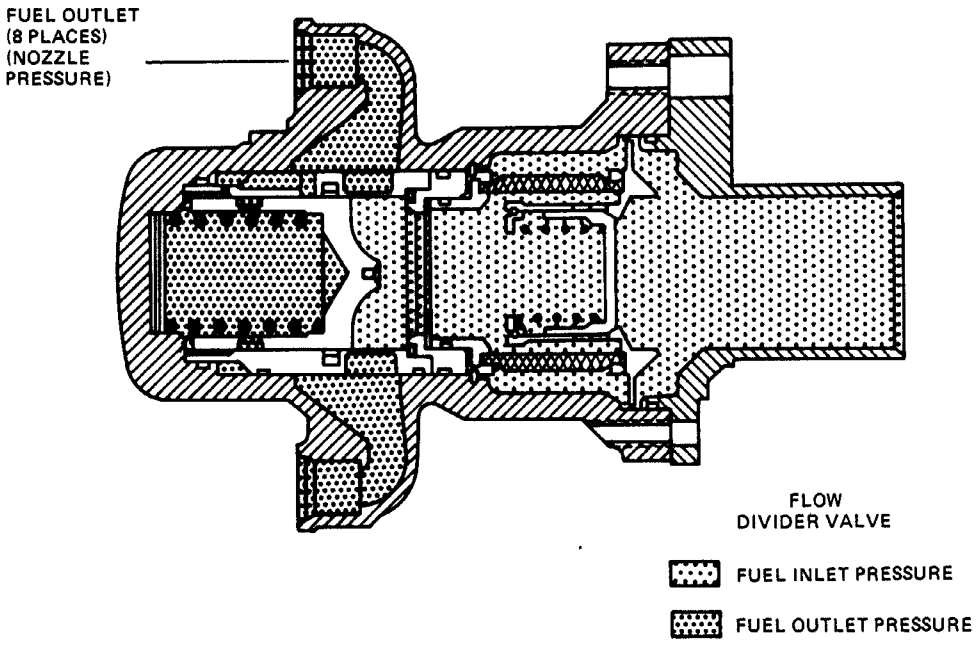
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Fuel Distribution Valve (Sheet 1/2)
Figure 003



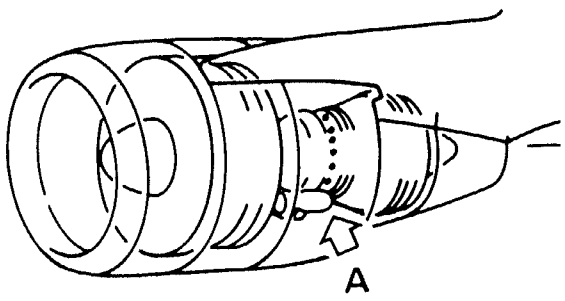


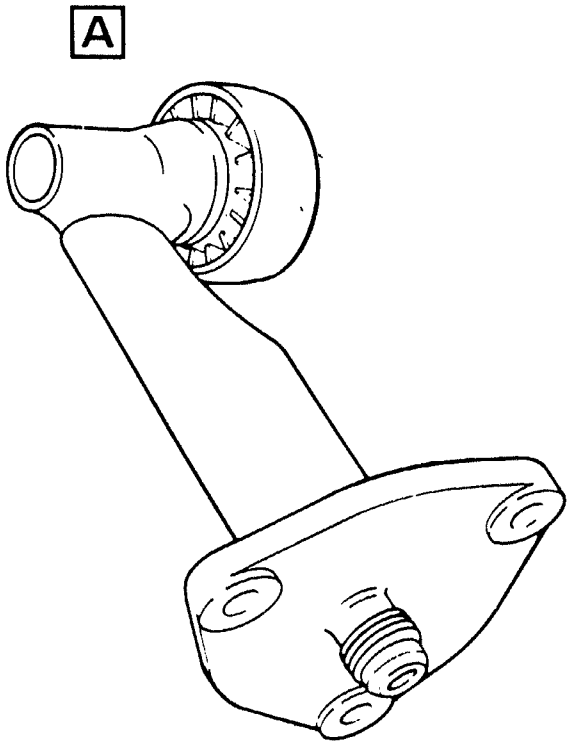
Fuel Distribution Valve (Sheet 2/2)
Figure 003



BM5 73 13 00 0 KFMO-20

Flow Divider Valve
Figure 004

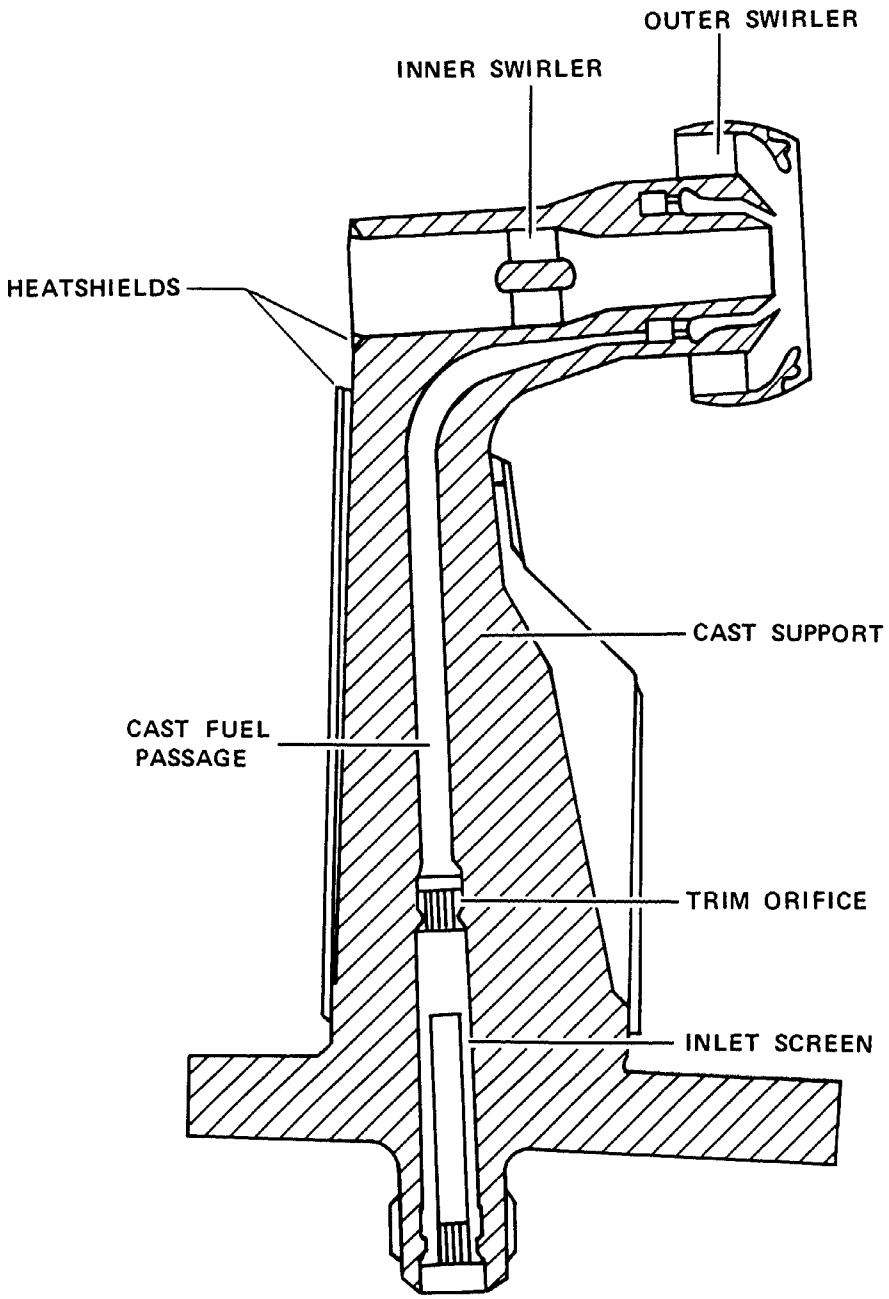




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DM5

L-A4075

Fuel Injector and Support Assembly
Figure 005



BM5 73 13 00 0 KJMO - 19

Injector
Figure 006

FUEL DISTRIBUTION VALVE - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Closures
C.	Torque Wrench
D.	Packings
E.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
F.	Jackscrews (190-32)
G. Material No.P03-001	Oils (Ref. 70-00-00)
H. Material No.P05-289	Special Materials (Ref. 70-00-00)
I. Material No.P05-291	Special Materials (Ref. 70-00-00)
J. Material No.P05-292	Special Materials (Ref. 70-00-00)
K. Material No.P06-002	Lubricants (Ref. 70-00-00)
L. Material No.P06-007	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant - General

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the appropriate circuit breakers and open thrust reverser doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401, 402)
(1)(Pre SB PW4ENG 73-84), disconnect W5P8 harness connector from fuel temperature probe on fuel pump filter housing. Install protective closures.
(2)(Post SB PW4ENG 73-84), remove the harness connector from the thermocouple probe as follows.
(a)Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.
(b)Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.
(c)Remove the wiring harness terminals from the thermocouple studs.
(d)Install protection covers.
(3)Remove bolts securing front and rear flanges of fuel flowmeter support and two brackets to fuel flowmeter and to fuel distribution valve. Remove brackets and fuel flowmeter support from engine.
(4)Be prepared to receive approximately one quart (one liter) of fuel from transfer tube connection.
(5)Translate packing transfer tube assembly rearward into distribution valve cover.
(6)Remove two bolts securing forward end of valve to bracket on Flange J.
(7)Remove four bolts securing valve to bracket on Flange K and remove valve

from engine using two (190-32) jackscrews. Remove jackscrews.

(8) Remove transfer tube from adapter on each fuel supply tube. Discard packings.

(9) Remove transfer tube from valve. Remove and discard packings from transfer tube.

(10) Install protective closures.

C. Installation (Ref. Fig. 401, 402)

(1) Remove protective closures.

CAUTION : USE PETROLEUM JELLY (MATERIAL NO.P06-007) AS A LUBRICANT OR AS AN ASSEMBLY AID TO HOLD PARTS TOGETHER. DO NOT USE ENGINE OIL.

(2) Install two new packings, lubricated with Petroleum Jelly (Material No.P06-007), to eight transfer tubes. Install transfer tubes to adapters on fuel supply tubes at bracket on Flange K.

(3) Install two new packings, lubricated with Petrolatum White (Material No.P06-002), to packing transfer tube. Install packing transfer tube longer end into the valve opening.

(4) Install fuel distribution valve over above installed transfer tubes aligning pins on valve with holes in Flange K bracket and front mount with bracket on Flange J.

(a) (Pre SB PW4ENG 73-170) Secure valve to bracket on Flange K with four bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

(b) (Post SB PW4ENG 73-170) Secure valve to bracket on Flange K with four bolts. TORQUE bolts to between 62 and 72 lbf.in. (0.71 and 0.81 m.daN).

NOTE : Pre SB PW4ENG 73-170 bolts are too short to reliably engage the helicoil locking feature and are not coated with an anti-gallant that would help to improve disassembly.
Post SB PW4ENG 73-170 bolts are of sufficient length to properly engage the helicoil insert locking feature and have an anti-gallant coating applied to the threads. Do not apply Engine Oil to the threads of the four bolts.

(5) Secure valve to Flange J bracket with two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

(6) Translate packing transfer tube forward with dowel pin downward and boltholes aligned.

(7) Install fuel flowmeter support over transfer tube aligning dowel pin on transfer tube with slot in support and aligning boltholes in rear flange. Install bracket over support and position as referenced in (Ref. Fig. 401).

(8) Secure rear flange with bolts (without drilled heads), threads lubricated with Engine Oil (Material No.P03-001). Secure front flange with drilled head bolts, threads lubricated with Engine Oil (Material No.P03-001).

(9) TORQUE all bolts at front and rear flanges to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts on the front flange.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(10)(Pre SB PW4ENG 73-84), connect W5P8 harness connector to fuel temperature probe on fuel pump filter housing as follows :

(11)(Post SB PW4ENG 73-84), for a thermocouple probe with a studded terminal type receptacle install the wiring harness as follows.

(a)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.

(b)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(c)If necessary to align the thermocouple stud box, remove the lockwire from the thermocouple coupling nut to the adapter and loosen the coupling nut.

(d)Align the thermocouple stud box with the wiring harness connector.

(e)(Reference 2167) hold the thermocouple stud box and torque the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.

(f)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(g)(Reference 2163) torque the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.21 and 0.24 m.daN).

(h)(Reference 2164) torque the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(i)Install lockwire from the coupling nut to the adapter.

(j)Torque the bolt that attachs the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN).

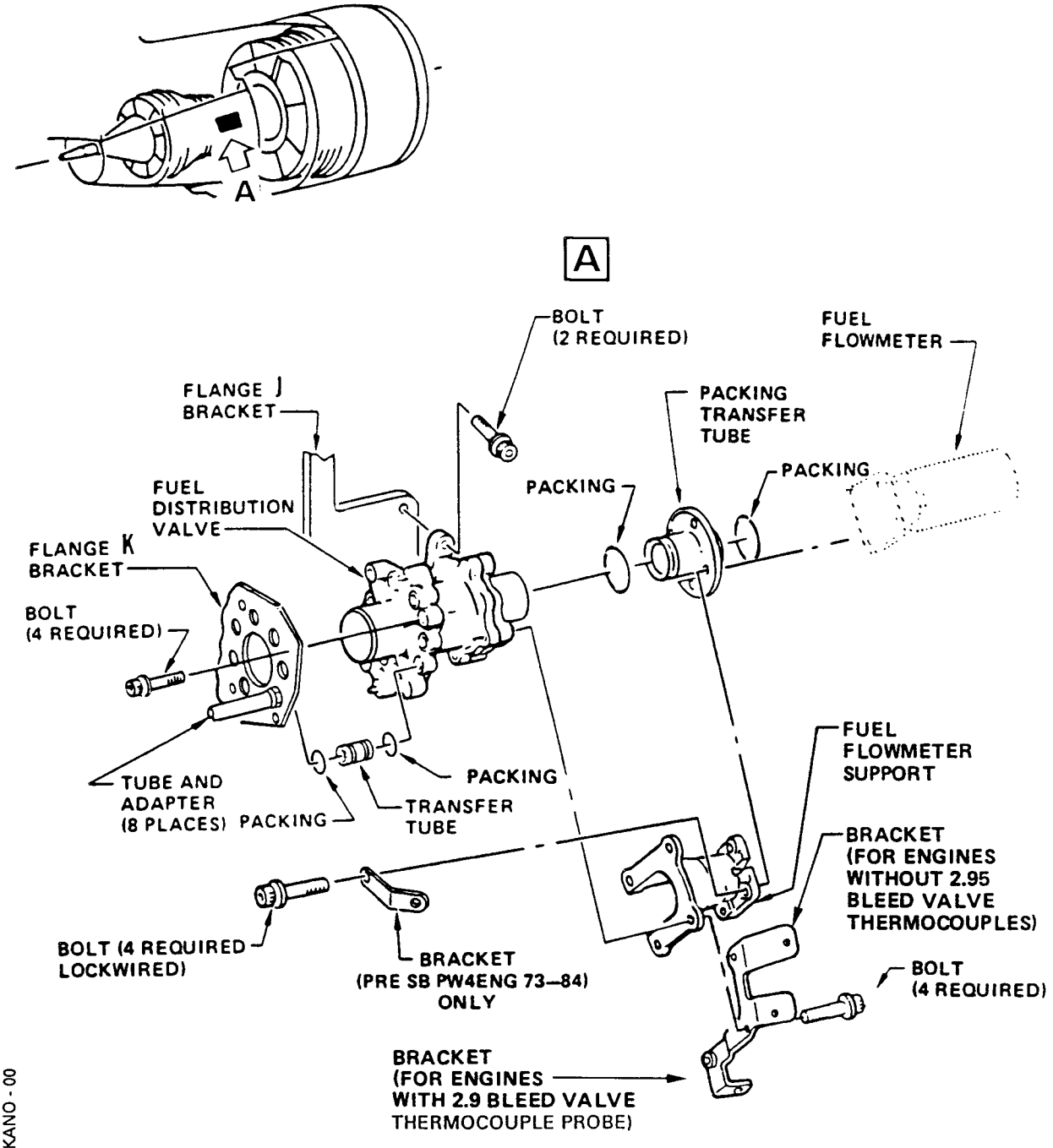
D. Close Up and Test.

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close thrust reverser doors (Ref. 71-13-00, P. Block 301).

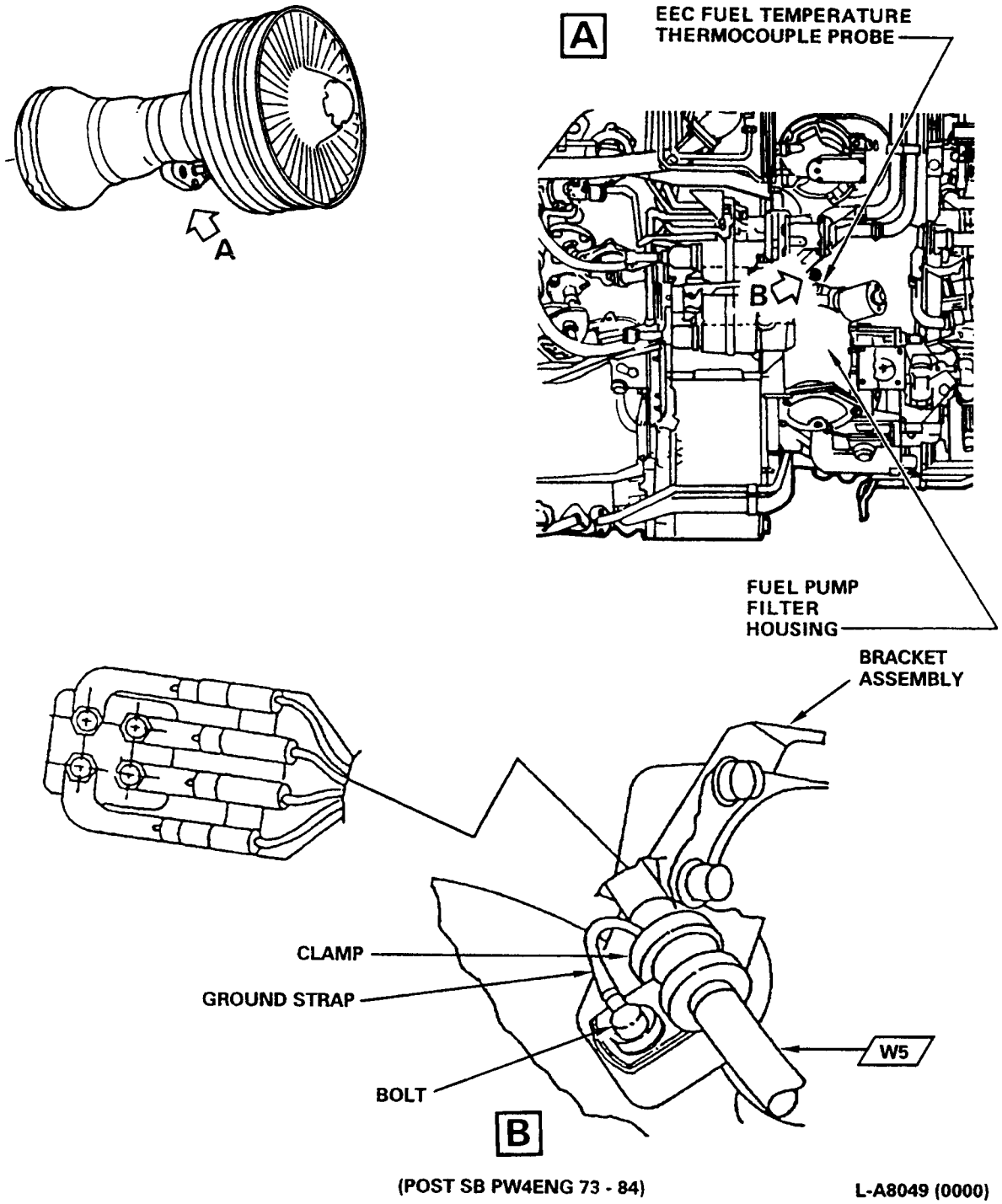
(3)Remove safety clips and tags and close circuit breakers.

(4)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



BM5 73 13 04 4 KANO - 00

Fuel Distribution Valve
Figure 401



BM5 73 13 04 4 KCMO - 00

Fuel Distribution Valve (Post SB PW4ENG 73-84)
Figure 402

FUEL DISTRIBUTION VALVE STRAINER - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Closures
C. Material No.P03-001	Oils (Ref. 70-00-00)
D. Material No.P06-002	Lubricants (Ref. 70-00-00)
E.	Packings
F.	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
G. PWA86459	Puller, Strainer
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors
- 73-13-05, P. Block 601	Fuel Distribution Valve Strainer
- 73-13-05, P. Block 701	Fuel Distribution Valve Strainer

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the appropriate circuit breakers, and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401, 402)

(1)(Pre SB PW4ENG 73-84) disconnect W5P8 harness connector from fuel temperature probe on fuel pump filter housing. Install protective closures.

(2)(POST SB PW4 ENG 73-84), remove the harness connector from the thermocouple probe as follows.

(a)Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.

(b)Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.

(c)Remove the wiring harness terminals from the thermocouple studs.

(d)Install protection covers.

(3)Remove bolts securing front and rear flanges of fuel flowmeter support and brackets to fuel flowmeter and to fuel distribution valve. Remove fuel flowmeter support and brackets from engine.

(4)Be prepared to receive approximately one quart (one liter) of fuel from transfer tube connection.

(5)Translate packing transfer tube assembly rearward into distribution valve cover.

(6)Removebolts and washers securing strainer housing cover to distribution valve and remove cover and tube from valve. Remove tube from cover. Discard packings from tube and cover.

CAUTION : USE THE PWA 86459 PULLER TO AVOID DAMAGE TO THE STRAINER.

(7)Engage the PWA 86459 Puller to the strainer and pull the strainer from the housing. Disengage the puller from the strainer and remove the puller

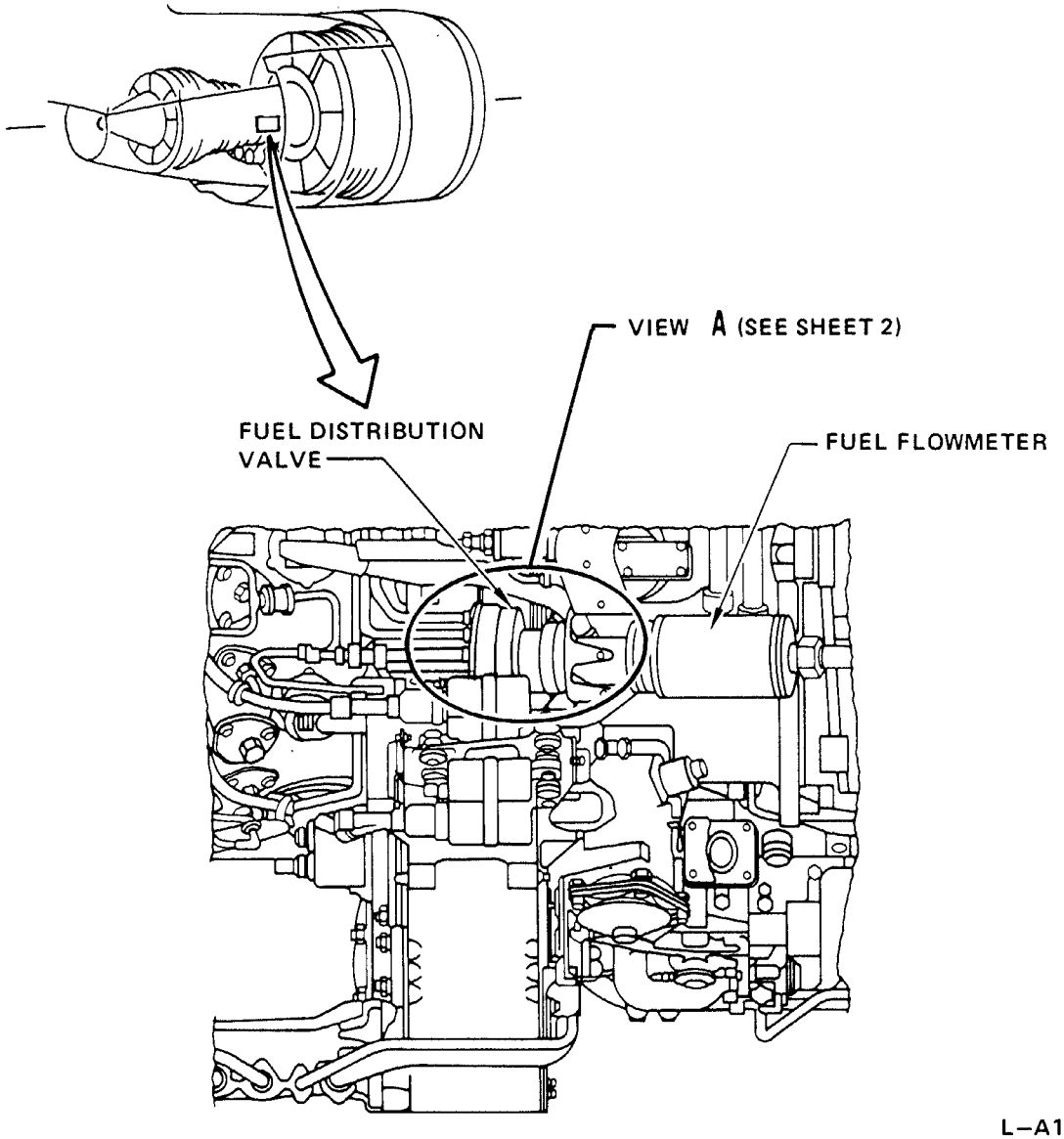
and the strainer from the engine separately.
(8)Inspect fuel distribution valve strainer (Ref. 73-13-05, P. Block 601).
(9)Clean fuel distribution valve strainer (Ref. 73-13-05, P. Block 701).
(10)Install protective closures.

C. Installation (Ref. Fig. 401, 402)
(1)Remove protective closures.
(2)Install packing lubricated with Material No.P06-002, to groove on end of strainer and install fuel strainer to ID of fuel distribution valve.
(3)Install two packings lubricated with Material No.P06-002, to grooves in packing transfer tube assembly. Install valve transfer tube into valve cover.
(4)Install packing lubricated with Material No.P06-002, to cover and install cover to fuel distribution valve housing. Secure cover with bolts threads lubricated with Material No.P03-001. TORQUE bolts to between 30 and 33 lbf.in. (0.34 and 0.37 m.daN).
(5)Translate transfer tube forward with dowel pin downward and bolt holes aligned.
(6)Install fuel flowmeter support over transfer tubes aligning dowel pin on transfer tube with slot in support and aligning bolt holes in rear (larger) flange. Install brackets over support and position as referenced in (Ref. Fig. 401)
NOTE : Ensure sealplate is installed against rear flange of fuel flowmeter and dowel pin is aligned.
(7)Secure rear flange with bolts (without drilled heads) lubricated with Material No.P03-001. Secure front flange with drilled head bolts lubricated with Material No.P03-001.
(8)TORQUE all bolts at front and rear flanges to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN). Wirelock bolts on front flange.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(9)(Pre SB PW4ENG 73-84), connect W5P8 harness connector to fuel temperature probe on fuel pump filter housing as follows :

(10)(POST SB PW4ENG 73-84), for a thermocouple probe with a studded terminal type receptacle install the wiring harness as follows.
(a)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.
(b)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.
CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.
(c)If necessary to align the thermocouple stud box, remove the lockwire from the thermocouple coupling nut to the adapter and loosen the coupling nut.
(d)Align the thermocouple stud box with the wiring harness connector.

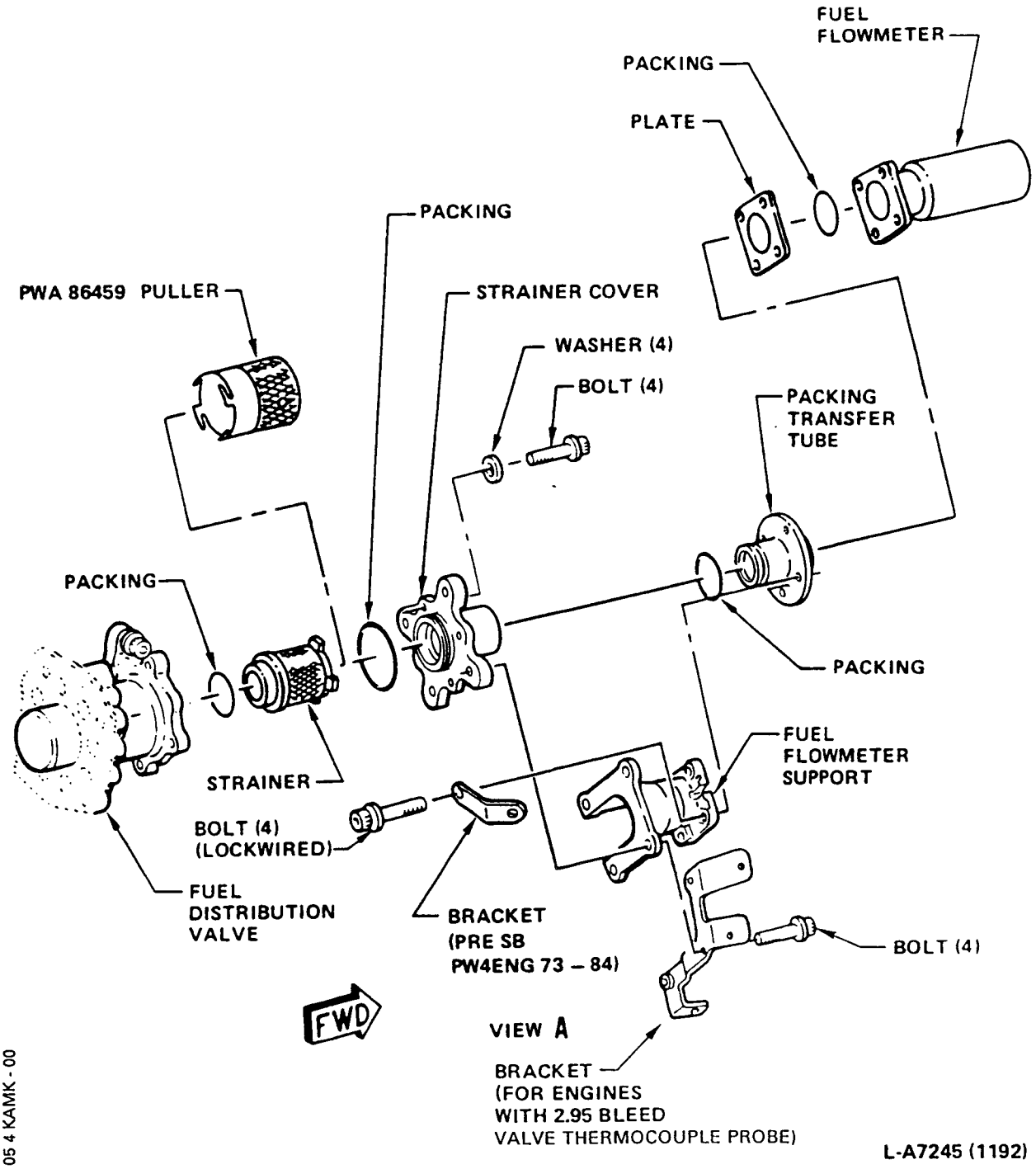
(e)(Reference 2167) Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.
CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.
(f)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.
CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.
(e)(Reference 2163) TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.21 and 0.24 m.daN).
(f)(Reference 2164) TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).
(g)Install lockwire from the coupling nut to the adapter.
(h)TORQUE the bolt that attachs the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN).

D. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(3)Remove safety clips and tags and close circuit breakers.
(4)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



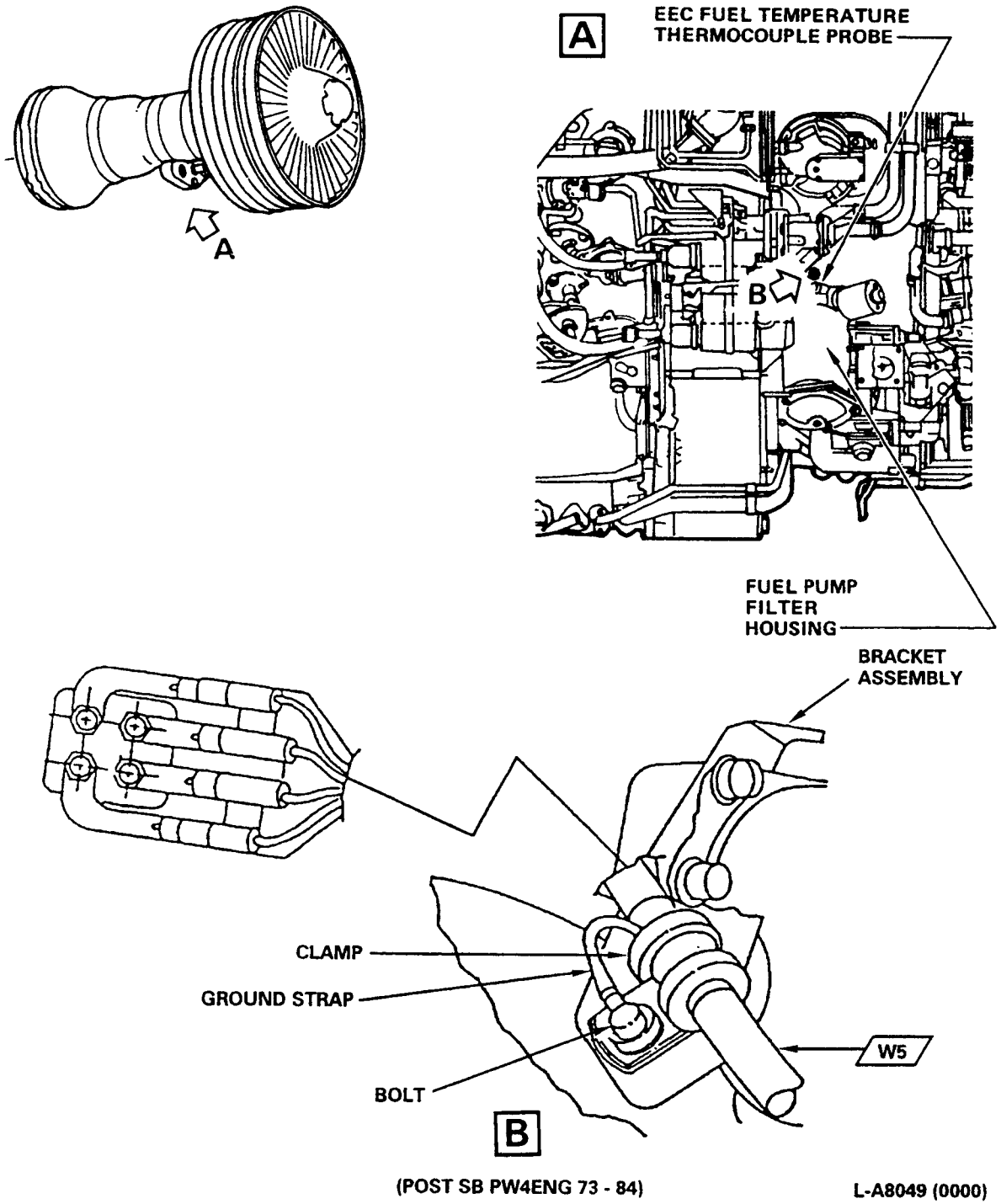
BMS 73 13 05 4 KAMA - 20

Fuel Distribution Valve Strainer (Sheet 1/2)
Figure 401



BM5 73 13 05 4 KAMK - 00

Fuel Distribution Valve Strainer (Sheet 2/2)
Figure 401



BM5 73 13 05 4 KCMO - 00

Fuel Distribution Valve Strainer (Post SB PW4ENG 73-84)
Figure 402

FUEL DISTRIBUTION VALVE STRAINER - INSPECTION/CHECK

1. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 73-12-03, P. Block 601	Fuel Pump Filter
- 73-13-04, P. Block 401	Fuel Distribution Valve
- 73-13-05, P. Block 701	Fuel Distribution Valve

2. Procedure

A. Job Set-Up
(1)Remove fuel distribution valve (Ref. 71-13-04, P. Block 401).

B. Inspection/Check
(1)Inspect strainer for evidence of damage or an accumulation of contamination.
(2)Clean strainer (Ref. 73-13-05, P. Block 701).
(3)In the presence of heavy contamination, inspect upstream filter element in fuel pump (Ref. 73-12-03, P. Block 601).

C. Close-Up
(1)Install fuel distribution valve (Ref. 71-13-04, P. Block 401).

FUEL DISTRIBUTION VALVE STRAINER - CLEANING/PAINTING

1. Reason for the Job

A. Cleaning procedure for strainers that have small quantities of contamination.

B. Cleaning procedure for strainers that have large quantities of contamination.

2. Job Set-Up

A. Remove fuel distribution valve strainer (Ref. 73-13-05, P. Block 401).

B. Do fuel distribution valve strainer inspection (Ref. 73-13-05, P. Block 601).

3. Clean Fuel Distribution Valve Strainer (Small Quantities of Contamination

A. Equipment and Materials

ITEM	DESIGNATION
(1)	Fluid Drain Collector/Container
(2)	Compressed Dry Filtered Air Source up to 30 psi (up to 200 kPa)
(3)Material No.P11-027	Cleaning Agents (Ref. 70-00-00)
Referenced Procedures	
- 73-13-05, P. Block 401	Fuel Distribution Valve Strainer
- 73-13-05, P. Block 601	Fuel Distribution Valve Strainer

B. Procedure

CAUTION : DO NOT USE PAPER TO CLEAN OR DRY PARTS. LINT FROM THE PAPER CAN CAUSE BLOCKAGE DOWNSTREAM.
DO NOT CLEAN THE STRAINER WITH A WIRE BRUSH, A PROBE, OR AN OTHER EQUIVALENT DEVICE. THESE DEVICES CAN CAUSE DAMAGE TO THE WIRE MESH SCREEN.

(1)Put strainer in a container full of Material No.P11-027 and move the strainer around quickly.

WARNING : DO NOT USE COMPRESSED AIR WITHOUT THE APPROVED PROTECTION. THE AIR PRESSURE MUST BE NO MORE THAN 30 psi (200 kPa). COMPRESSED AIR CAN CAUSE INJURY TO PERSONS WITHOUT GOGGLES OR A FACE SHIELD.

(2)Clean wire mesh screen on the strainer with compressed air at no more than 30 psi (200 kPa).

C. Close-Up

(1)Install fuel distribution valve strainer (Ref. 73-13-05, P. Block 401).

4. Clean Fuel Distribution Valve Strainer (Large Quantities of Contamination

A. Equipment and Materials

ITEM	DESIGNATION
(1)	Fluid Drain Collector/Container
(2)	Soft Bristle Brush
(3)Material No.P11-027	Cleaning Agents (Ref. 70-00-00)
Referenced Procedures	
- 73-13-05, P. Block 401	Fuel Distribution Valve Strainer
- 73-13-05, P. Block 601	Fuel Distribution Valve Strainer

B. Procedure

CAUTION : DO NOT USE PAPER TO CLEAN OR DRY PARTS. LINT FROM THE PAPER CAN CAUSE BLOCKAGE DOWNSTREAM.
DO NOT CLEAN THE STRAINER WITH A WIRE BRUSH, A PROBE, OR AN OTHER EQUIVALENT DEVICE. THESE DEVICES CAN CAUSE DAMAGE TO THE WIRE MESH SCREEN.

(1)Put strainer in a container full of Material No.P11-027, and let the strainer soak for 10 minutes.
(2)Remove strainer from the container of solvent.
(3)Remove contamination from the wire mesh screen with a soft bristle brush.

C. Close-Up

(1)Install fuel distribution valve strainer (Ref. 73-13-05, P. Block 401).

FUEL INJECTOR AND SUPPORT - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Closures
C.	Container
D.	Gaskets
E.	Packings
F.	Torque Wrench
G.	Access Platform
H.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
I. PWA85579	Adapter
J. Material No.P03-001	Oils (Ref. 70-00-00)
K. Material No.P05-007	Special Materials (Ref. 70-00-00)
L. Material No.P05-059	Special Materials (Ref. 70-00-00)
M. Material No.P05-289	Special Materials (Ref. 70-00-00)
N. Material No.P05-291	Special Materials (Ref. 70-00-00)
O. Material No.P05-292	Special Materials (Ref. 70-00-00)
R P. Material No.P06-054	Lubricants (Ref. 70-00-00)
Q. Material No.P06-007	Lubricants (Ref. 70-00-00)
R. Material No.P06-015	Lubricants (Ref. 70-00-00)
S. Material No.P06-035	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 71-13-00, P. Block 301	Cowl Doors
- 80-13-01, P. Block 401	Pneumatic Starter Assy
- 24-11-11, P. Block 401	Integrated Drive Generator
- 79-11-00, P. Block 401	Oil Tank
- 75-23-02, P. Block 401	Turbine Case Cooling (TCC) Air Shutoff Valve (HPT)
- 71-00-00, P. Block 501	Power Plant - General
- 71-70-51, P. Block 401	Engine Drain Lines
- 75-23-12, P. Block 401	Turbine Case Cooling (TCC) Inlet Duct
- 36-11-00, P. Block 401	Engine Bleed Air Supply System
- 73-31-11, P. Block 401	Fuel Flow Transmitter

2. Procedure

A. Job Set-Up
(1) Open, safety and tag appropriate circuit breakers and open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(2) To gain access to fuel injector 5, remove TCC duct assembly (Ref. 75-23-12, P. Block 401).
(3) To gain access to fuel injectors 9 and 10, remove bolts attaching right hydraulic pump heat shield to mounting brackets and remove heat shield. (Ref. Fig. 401)
(4) To gain access to fuel injectors 11 and 12, remove pneumatic starter (Ref. 80-13-01, P. Block 401).

(5)To gain access to fuel injectors 13, 14 and 15, remove integrated drive generator (IDG) (Ref. 24-11-11, P. Block 401). Remove bolts attaching IDG heat shield to mounting brackets and remove heat shield.
(6)To gain access to fuel injectors 16 and 17, remove oil tank (Ref. 79-11-00, P. Block 401).
(7)To gain access to fuel injector 19, remove 15th stage manifold (Ref. 36-11-00, P. Block 401) and pylon drain tube (Ref. 71-70-51, P. Block 401).
(8)To gain access to fuel injector 20, remove turbine vane cooling air
R duct (upper left) (Ref. 75-23-02, P. Block 401).
(9)To gain access to fuel injector 7, remove turbine vane cooling air duct (lower right) (Ref. 75-2
(10)Install access platform.

B. Removal (Ref. Fig. 401, 402, 403)
(Ref. Fig. 406, 407)
(1)If access to injector No. 22 is required, remove diffuser seal air vent tube (AP22) (left).
(a)For engine in Pre SB PW4ENG 72-567 (Ref. Fig. 402).
1 Remove lockwire or safety cable and disconnect tube nut from diffuser case internal tube at approximately 11 o'clock position.
2 Loosen bolts, nuts, and clamps securing PT4.95 tube and air shutoff valve signal tube to bracket attached to forward end of tube.
3 Remove lockwire or safety cable and bolts, securing tube elbow and bracket to HPC rear case.
4 Remove bolt, nut, and clamp securing tube to bracket at No. 21 fuel injector.
5 Remove tube from engine and remove deflector from HPC case. Remove and discard gaskets. Install protective closures.
6 Disconnect cable from bracket mounted to nozzle.
(b)For engine in Post SB PW4ENG 72-567 (Ref. Fig. 403)
CAUTION : WHEN YOU REMOVE THE (AP22) LEFT SIDE TUBE LOCK FROM THE INTERNAL DIFFUSER SEAL AIR VENT TUBE ASSEMBLY, YOU MUST BE CAREFUL THAT THE AIR VENT TUBE DOES NOT FALL INTO THE DIFFUSER CASE. AS A PRECAUTION, ATTACH A TEMPORARY SAFETY WIRE AROUND THE INTERNAL DIFFUSER SEAL AIR VENT TUBE ASSEMBLY SO IT WILL NOT FALL INTO THE DIFFUSER CASE. IF THE AIR VENT TUBE FALLS INTO THE DIFFUSER CASE IT IS POSSIBLE THAT MORE ENGINE DISASSEMBLY WILL BE NECESSARY TO GET ACCESS TO REMOVE THE TUBE.
1 Remove the lockwire or the safety cable and disconnect tube from diffuser case internal tube at approximately 11 o'clock position.
2 Loosen bolts, nuts, and clamps securing tubes to bracket attached to forward end of tube.
3 Remove lockwire or safety cable and bolts securing tube elbow and bracket to HPC rear case.
4 Remove bolt, nut and clamp securing tube to bracket at No. 21 fuel injector.
5 Remove tube from engine and remove deflector from HPC case. Remove gaskets and locks. Discard gaskets and install protective closures.
6 Disconnect cable from bracket mounted to nozzle.

(2)If access to injector 18 is required, disconnect oil quantity transmitter cooling air hose from transmitter shroud and remove No. 4 bearing pressure tube.
(a)Loosen clamps securing hose to transmitter shroud and tube. Remove hose.
(b)Remove hose clamps securing shield to tube ends. Remove shield.
(c)Remove loop clamps securing tube and shield.
(d)Cut and remove lockwire or safety cable at tube nuts. Loosen tube nuts. Remove tube.

R **ON A/C 101-105,

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B. Removal (Ref. Fig. 401, 403)
(Ref. Fig. 406, 407)
CAUTION : WHEN YOU REMOVE THE (AP22) LEFT SIDE TUBE LOCK FROM THE INTERNAL DIFFUSER SEAL AIR VENT TUBE ASSEMBLY, YOU MUST BE CAREFUL THAT THE AIR VENT TUBE DOES NOT FALL INTO THE DIFFUSER CASE. AS A PRECAUTION, ATTACH A TEMPORARY SAFETY WIRE AROUND THE INTERNAL DIFFUSER SEAL AIR VENT TUBE ASSEMBLY SO IT WILL NOT FALL INTO THE DIFFUSER CASE. IF THE AIR VENT TUBE FALLS INTO THE DIFFUSER CASE IT IS POSSIBLE THAT MORE ENGINE DISASSEMBLY WILL BE NECESSARY TO GET ACCESS TO REMOVE THE TUBE.
(1)If access to fuel injector No. 22 is required, remove diffuser seal air vent tube (AP22) (left). (Ref. Fig. 403).
(a)Remove the lockwire or safety cable and disconnect tube nut from diffuser case internal tube at approximately 11 o'clock position.
(b)Loosen bolts, nuts, and clamps securing tubes to bracket attached to forward end of tube.
(c)Remove lockwire or safety cable and bolts securing tube elbow and bracket to HPC rear case.
(d)Remove bolt, nut and clamp securing tube to bracket at No. 21 fuel injector.
(e)Remove tube from engine and remove deflector from HPC case. Remove gaskets and locks. Discard gaskets and install protective closures.
(f)Disconnect cable from bracket mounted to nozzle.
(2)If access to injector 18 is required, disconnect oil quantity transmitter cooling air hose from transmitter shroud and remove No. 4 bearing pressure tube.
(a)Loosen clamps securing hose to transmitter shroud and tube. Remove hose.
(b)Remove hose clamps securing shield to tube ends. Remove shield.
(c)Remove loop clamps securing tube and shield.
(d)Cut and remove lockwire or safety cable at tube nuts. Loosen tube nuts. Remove tube.

**ON A/C 101-200,

(3)If access to injector 12 is required, remove lower right turbine blade cooling air tube. (Ref. Fig. 404)
(a)Remove lockwire, bolts, and bracket securing tube flange to diffuser, case at approximately 5 o'clock position.
(b)Remove bolts and bracket securing tube flange to turbine vane and blade cooling air valve on HPC case.
(c)Remove bolts, nuts, and clamps securing tube to diffuser case brackets.
Pre SB PW4 ENG 72-572 or Pre SB PW4 ENG 72-537 or Post SB PW4 ENG 72-627
(d)Remove the tube from the engine. Remove and discard the gaskets. Remove the metering plate and tube locks. Install the protective closures.
Post SB PW4 ENG 72-572 and Pre SB PW4 ENG 72-627
or Post SB PW4 ENG 72-537 and Pre SB PW4 ENG 72-627
(d)Remove the tube from the engine. Remove and discard the gaskets. Remove the ring spacer and tube locks. Install the protective closures.
End of All SBs

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

(3)If access to injector 12 is required, remove lower right turbine blade cooling air tube. (Ref. Fig. 405)
(a)Remove lockwire, bolts, and bracket securing tube flange to diffuser, case at approximately 5 o'clock position.
(b)Remove bolts and bracket securing tube flange to turbine vane and blade cooling air valve on HPC case.
(c)Remove bolts, nuts, and clamps securing tube to diffuser case brackets.
Pre SB PW4 ENG 72-537 or Post SB PW4 ENG 72-627
(d)Remove the tube from the engine. Remove and discard the gaskets. Remove the metering plate and tube locks. Install the protective closures.
Post SB PW4 ENG 72-537 and Pre SB PW4 ENG 72-627
(d)Remove the tube from the engine. Remove and discard the gaskets. Remove the ring spacer and tube locks. Install the protective closures.
End of All SBs

**ON A/C 101-200,

(4)If access to injector 13 is required, remove No.3 bearing oil scavenge tube. (Ref. Fig. 406)
Pre SB PW4 ENG 79-46
(a)Remove nut, bolt, and clamp securing manifold (LR04) to oil pump bracket. Manifold (LR05) is also secured to this bracket with the same nut and bolt (Ref. Fig. 406) (Sheet 1).
Post SB PW4 ENG 79-46 and Pre SB PW4 ENG 79-75

(b)Remove nut, bolt, and clamp securing manifold (LR04) to oil pump bracket. Manifold (LR05) is also secured to this bracket with the same nut and bolt. Also remove the additional nut, bolt, grommet halves and clamp on (LR04) manifold where it is clamped to the (LR05) manifold (Ref. Fig. 406) (Sheet 2).

Post SB PW4 ENG 79-75

(c)Remove the nuts, bolts, and clamps that hold the hose and manifold assembly (LR04) to the fluid pressure dampener or (Post SB PW4ENG 79-86) adapter bracket and to the bracket mounted between fuel injector pads 12 and 13. Remove the bracket installed between fuel injector pads 12 and 13. (Ref. Fig. 406) (Sheet 3 through 6).

End of SB PW4 ENG 79-75)

(d)Remove lockwire and disconnect diffuser case internal tube nut from manifold elbow at 6 o'clock position.

(e)Remove bolts securing manifold to main oil pump. Remove manifold from engine.

NOTE : Catch oil in container with a capacity of approximately 5 U.S. gallons (19 liters).

(f)Remove and discard packing. Install protective closures.

(5)Remove lockwire and disconnect fuel supply tube from fuel injector supply manifold (Ref. Fig. 401).

NOTE : A small smount of fuel will drain from injector. Be prepared to catch fuel in suitable container.

(6)Remove lockwire and disconnect fuel injector supply manifold nuts from injector being removed and from two adjacent injectors supplied from same manifold.
Remove manifold and transfer tube.
Discard packings (Ref. Fig. 401).

(7)Remove lockwire and bolts securing injector being remove. Remove injector, gasket, and bracket (if applicable).
Discard gasket (Ref. Fig. 401, 407).

NOTE : Rotate and/or tilt injector as required to disengage injector from diffuser case.

Mark location of removed brackets to facilitate reassembly.

(8)Install protective closures.

C. Installation (Ref. Fig. 401, 406, 407)

(1)Remove protective closures.

(2)Install gasket, lubricated with Beeswax (Material No.P06-015), and fuel injector to boss on diffuser case. Rotate injector into position and tilt to engage burner.

(3)Install bracket (if applicable) to position marked at disassembly (Ref. Fig. 407). Secure injector with bolts, threads lubricated with Engine Oil (Material No.P03-001).
TORQUE bolts to between 65 and 85 lbf.in. (0.73 and 0.96 m.daN) then without loosening, continue to tighten to required torque until torque is maintained.
Install Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts.

(4)(Reference 407) Install packing, lubricated with Lubricating Fluid

(Material No.P06-035), to packing groove on just installed fuel injector and two adjacent injectors.

(5)(Reference 2152) Install two packings, lubricated with Lubricating Fluid (Material No.P06-035) in transfer tube.

(6)Install transfer tube into adapter on fuel supply manifold.

(7)Lubricate threads of injector adapters and adapter on fuel supply manifold with Engine Oil (Material No.P03-001) and install fuel injector supply manifold to injectors and to fuel supply tube, securing tube nuts handtight.

(8)Examine the appropriate tube and manifold connections for leaks as follows:

(a)Remove the fuel flow transmitter (Ref. 73-31-11, P. Block 401).

(b)Connect the PWA85579 adapter to the fuel distribution valve with the packing and bolts.

(c)Supply clean air through the (PWA85579) adapter between 95 and 105 psig. (655.0 and 723.9 kpa.).
Apply Leak Check (Material No.P05-007) and examine the connections for visible leaks from any surface or connections for a minimum of five minutes.
NOTE : Make certain all manifold and tube nuts that were disconnected are loose enough to find a leak in the transfer tube packings.

(d)If leakage is found, repair or replace the parts as necessary and repeat this test.

(e)If no leakage is found, remove the air source and the (PWA85579) adapter.

(f)Install the fuel flow transmitter (Ref. 73-31-11, P. Block 401).

(9)(Reference 2152) TORQUE tube nut to fuel supply manifold adapter to between 275 and 325 lbf.in. (3.11 and 3.67 m.daN).

(10)(Reference 2152) TORQUE the manifold nuts on the fuel injectors to between 185 and 200 lbf.in. (2.09 and 2.25 m.daN).

(11)Install Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nuts.

(12)If No. 3 bearing oil scavenge manifold (LR04) was removed for access to injector 13, comply with the following (Ref. Fig. 406).

(a)Remove protective closures and install packing lubricated with Engine Oil (Material No.P03-001), to packing groove at flanged end of manifold.

(b)Lubricate threads on manifold elbow with Engine Oil (Material No.P03-001), and install manifold to diffuser case internal tube nut at approximately 6 o'clock position, and to
R part on main oil pump with bolts, threads lubricated with Antiseize
R Compound (Material No.P06-054, handtight only.

Pre SB PW4 ENG 79-46

(c)Secure manifold to oil pump bracket with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut.
TORQUE clamp bolt between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
See view A
(Ref. Fig. 406) (Sheet 1).

Post SB PW4 ENG 79-46 and Pre SB PW4 ENG 79-75

(d)Secure the (LR04) manifold to oil pump bracket with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. Secure the (LR04) manifold to the (LR05) manifold with the loop clamp grommet halves, clamp, bolt threads lubricated with Engine Oil (Material No.P03-001), and nut. (Ref. Fig. 406) (Sheet 2). TORQUE clamp bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

Post SB PW4 ENG 79-75

(e)Secure the (LR04) hose and manifold assembly with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut to the bracket bolted to the fluid pressure dampener or (Post SB PW4ENG 79-86) adapter which is mounted on the top of the lubrication and scavenge oil pump. Also secure the (LR04) hose and manifold assembly with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut to the bracket installed between fuel injector pads 12 and 13. (Ref. Fig. 406) (Sheet 3 through 6). TORQUE clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

End of SB PW4 ENG 79-75

(f)TORQUE bolts securing manifold flange to main oil pump to between 62 and 72 lbf.in. (0.68 and 0.79 m.daN).

(g)TORQUE diffuser case internal tube nut to between 650 and 700 lbf.in. (7.34 and 7.90 m.daN), while holding manifold elbow from turning and secure with lockwire.

(13)If (lower right) turbine blade cooling air tube (AP37) was removed for access to injector 12, comply with the following (Ref. Fig. 404).

CAUTION : INSTALL LOCK PLATES WITH SLOT GROOVE OUTWARD. ENSURE LOCK PLATES ENGAGE INTERNAL TUBE LIP AS SHOWN IN (Ref. Fig. 404). DAMAGE TO ENGINE MAY RESULT IF LOCKS ARE NOT PROPERLY ENGAGED.

(a)Remove protective closures. Install gasket, with raised sealing surface visible, to elbow end of tube, aligning tube slot and four bolt holes. Secure in place with Paraffin Wax (Material No.P05-059). Install ring gasket to elbow groove with Paraffin Wax (Material No.P05-059). Install locks to engage diffuser case internal tube lip and secure in place with Paraffin Wax (Material No.P05-059).

(b)Hold the tube locks outward against the tube lip. Make certain the end of the internal tube is between 0.000 and 0.020 in. (0.000 and 0.508 mm) above the tube locks. If the measurement is not within this limit, install the locks again and make certain you engage the internal tube lip properly. (Ref. Fig. 404).

Pre SB PW4 ENG 72-527 or Pre SB PW4 ENG 72-537 or Post SB PW4 ENG 72-627

(c)Install gasket and metering plate to turbine vane and blade cooling air valve four hole flanged end of tube and hold in place with Paraffin Wax (Material No.P05-059). Install gasket to lower flanged opening of air valve and secure in place with Paraffin Wax (Material No.P05-059).

Post SB PW4 ENG 72-572 and Pre SB PW4 ENG 72-627 or
Post SB PW4 ENG 72-537 and Pre SB PW4 ENG 72-627

(c)Install the gasket and ring spacer to the turbine vane and blade cooling air valve four hole flanged end of the tube and hold in place with Paraffin Wax (Material No.P05-059). Install gasket to the lower flanged opening of the air valve and secure in place with Paraffin Wax (Material No.P05-059).

End of All SBs

(d)Secure elbow end of tube (gaskets in place) and bracket to diffuser case pad at approximately 5 o'clock position with bolts, threads lubricated with Engine Oil (Material No.P03-001), handtight only.

(e)Secure opposite end of tube (gasket and metering plate in place) to turbine vane and blade cooling air valve with bolts, threads lubricated with Engine Oil (Material No.P03-001) handtight only.

(f)Secure tube to three brackets on diffuser case with clamps, bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. TORQUE clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(g)TORQUE all bolts at each end of tube to between 85 and 90 lbf.in. (0.96 and 1.07 m.daN), then retorque to required limit without loosening until required torque is maintained. Secure bolts at diffuser case pad with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts.

(h)Secure fuel injector supply manifold to bracket attached to tube flange at diffuser case with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. TORQUE bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

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(13)If (lower right) turbine blade cooling air tube (AP37) was removed for access to injector 12, comply with the following (Ref. Fig. 405).

CAUTION : INSTALL LOCK PLATES WITH SLOT GROOVE OUTWARD. ENSURE LOCK PLATES ENGAGE INTERNAL TUBE LIP AS SHOWN IN (Ref. Fig. 405). DAMAGE TO ENGINE MAY RESULT IF LOCKS ARE NOT PROPERLY ENGAGED.

(a)Remove protective closures. Install gasket, with raised sealing surface visible, to elbow end of tube, aligning tube slot and four bolt holes. Secure in place with Paraffin Wax (Material No. P05-059). Install ring gasket to elbow groove with Paraffin Wax (Material No. P05-059). Install locks to engage diffuser case internal tube lip and secure in place with Paraffin Wax (Material No. P05-059).

(b)Hold the tube locks outward against the tube lip. Make certain the end of the internal tube is between 0.000 and 0.020 in. (0.000 and 0.508 mm) above the tube locks. If the measurement is not within this limit, install the locks again and make certain you engage the internal tube lip properly. (Ref. Fig. 405).

Pre SB PW4 ENG 72-537 and Post SB PW4 ENG 72-627

(c)Install gasket and metering plate to turbine vane and blade cooling air valve flanged end of tube. Secure in place with Paraffin Wax (Material No.P05-059). Install gasket to lower flanged opening of air valve and secure in place with Paraffin Wax (Material No.P05-059).

Post SB PW4 ENG 72-537 and Pre SB PW4 ENG 72-627

(c)Install gasket and ring spacer to turbine vane and blade cooling air valve flanged end of tube. Secure in place with Paraffin Wax (Material No.P05-059). Install gasket to lower flanged opening of air valve and secure in place with Paraffin Wax (Material No.P05-059).

End of All SBs

(d)Secure elbow end of tube (gaskets in place) and brackets to diffuser case pad at approximately 5 o'clock position with bolts, threads lubricated with Engine Oil (Material No.P03-001), handtight only.

(e)Secure opposite end of tube (gasket and metering plate in place) to turbine vane and blade cooling air valve with bolts, threads lubricated with Engine Oil (Material No.P03-001) handtight only.

(f)Secure tube to three brackets on diffuser case with clamps, bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. TORQUE clamp bolts to between 36 and 40 lbf. in. (0.41 and 0.45 m.daN).

(g)TORQUE all bolts at each end of tube between 85 and 90 lbf.in. (0.96 and 1.07 m.daN), then retorque to required limit without loosening until required torque is maintained. Secure bolts at diffuser case pad with Lockwire (Material No. P05-289) or Safety Cable (Material No. P05-291) and Safety Cable Ferrule (Material No. P05-292) to safety the bolts.

(h)Secure fuel injector supply manifold to bracket attached to tube flange at diffuser case with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. TORQUE bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

**ON A/C 101-200,

(14)If oil quantity transmitter cooling air hose and No. 4 bearing pressure tube was removed for access to injector No. 18, comply with the following.

(a)Remove protective closures and lubricate tube nut threads with
R Antiseize Compound (Material No.P06-054).

(b)Position tube to diffuser case and secure tube nuts, fingertight.

(c)Install clamps, bolts and nuts to secure tube. TORQUE clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(d)TORQUE tube nut attached to diffuser case internal tube coupling to between 675 and 750 lbf.in. (7.63 and 8.47 m.daN) and secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nut.

(e)TORQUE manifold nut to strainer housing to between 340 and 375 lbf.in. (3.85 and 4.23 m.daN) and secure with Lockwire (Material No.P05-289)

or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nut.

(f)Position spray shield to inboard side of connection and secure to manifold with hose clamp. TORQUE hose clamp to between 40 and 45 lbf.in. (0.46 and 0.50 m.daN).

(g)Position cooling air hose to tube and oil quantity transmitter shroud. Secure hose with clamps. TORQUE clamps to between 25 and 30 lbf.in. (0.29 and 0.34 m.daN).

(15)(Pre SB PW4ENG 72-567) If (left) diffuser seal air vent tube (AP22) was removed for access to injector No. 22, comply with the following. (Ref. Fig. 402).

(a)Remove protective closures. Install gasket to groove in HPC rear case boss at approximately 10:30 o'clock position. Install deflector aligning pin with hole in HPC rear case boss.

R (b)Lubricate tube nut threads with Antiseize Compound (Material
R No.P06-054). Install gasket to flanged end of tube and secure in place with Paraffin Wax (Material No.P05-059).

(c)Install tube to engine and connect tube nut to diffuser case internal tube at approximately 11 o'clock position handtight only.

(d)Install bracket and bolts, threads lubricated with Engine Oil (Material No.P03-001), to secure flanged end of tube to HPC rear case handtight only.

(e)Secure tube to bracket at No. 21 fuel injector with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. TORQUE clamp bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(f)TORQUE tube nut to between 825 and 900 lbf.in. (9.33 and 10.16 m.daN) and secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nut.

(g)TORQUE bolts securing tube flange to HPC rear case to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN) then retorque without loosening until required torque is maintained and secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts.

(h)Secure PT 4.95 tube and air shutoff valve signal tube to bracket at flanged end of vent tube with clamps, bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. TORQUE clamp, bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(16)(Post SB PW4ENG 72-567) If (left) diffuser seal air vent tube (AP22) was removed for access to injector No. 22, comply with the following. (Ref. Fig. 403).

NOTE : Make sure to remove the temporary safety wire that is around the internal diffuser seal air vent tube assembly before you install the tube locks. Be careful not to let the tube drop into the diffuser case after you remove the temporary safety wire.

(a)Remove protective closures from tube ends.

(b)Install locks to diffuser case internal tube at approximately 11:00 o'clock position. Secure in place using small amount of Paraffin Wax (Material No.P05-059).

(c)Position new diffuser case tube gasket to ID of tube aligning bolt holes and tube opening and raised surface of gasket inboard. Secure in

place using small amount of Paraffin Wax (Material No.P05-059). Install second new gasket to groove in tube flange and secure in place with small amount of Paraffin Wax (Material No.P05-059).

(d)Install ten bolts, threads lubricated with Engine Oil (Material No.P03-001), securing tube and bracket to locks and diffuser case handtight only.

(e)Install gasket to groove in HPC rear case boss at approximately 10:30 o'clock position. Install deflector aligning pin with hole in HPC rear case boss.

R (f)Lubricate tube nut threads with Antiseize Compound (Material
R No.P06-054). Install gasket to flanged end of tube and secure in place with Paraffin Wax (Material No.P05-059).

(g)Install bracket and bolts, threads lubricated with Engine Oil (Material No.P03-001), to secure flanged end of tube to HPC rear case handtight only.

(h)Secure tube to bracket at No. 21 fuel injector with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. TORQUE clamp bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(i)TORQUE tube bolts securing tube to the diffuser case to between 65 and 85 lbf.in. (0.74 and 0.96 m.daN), then without loosening, retorque to required limit until proper torque is maintained. Secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(j)TORQUE bolts securing tube flange and bracket to HPC rear case to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN) then retorque to same limit without loosening until torque is maintained and secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts.

(k)Secure PT4.95 tube and air shutoff valve signal tube to bracket at flanged end of vent tube with clamps, bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. TORQUE clamp, bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

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(15)If (left) diffuser seal air vent tube (AP22) was removed for access to injector No. 22, comply with the following. (Ref. Fig. 403)

NOTE : Make sure to remove the temporary safety wire that is around the internal diffuser seal air vent tube assembly before you install the tube locks. Be careful not to let the tube drop into the diffuser case after you remove the temporary safety wire.

(a)Remove protective closures from tube ends.

(b)Install locks to diffuser case internal tube at approximately 11:00 o'clock position. Secure in place using small amount of Paraffin Wax (Material No.P05-059).

(c)Position new diffuser case tube gasket to ID of tube aligning bolt holes and tube opening and raised surface of gasket inboard. Secure in place using small amount of Paraffin Wax (Material No.P05-059). Install

second new gasket to groove in tube flange and secure in place with small amount of Paraffin Wax (Material No.P05-059).

(d)Install ten bolts, threads lubricated with Engine Oil (Material No.P03-001), securing tube and bracket to locks and diffuser case handtight only.

(e)Install gasket to groove in HPC rear case boss at approximately 10:30 o'clock position. Install deflector aligning pin with hole in HPC rear case boss.

R (f)Lubricate tube nut threads with Antiseize Compound (Material
R No.P06-054). Install gasket to flanged end of tube and secure in place with Paraffin Wax (Material No.P05-059).

(g)Install bracket and bolts, threads lubricated with Engine Oil (Material No.P03-001), to secure flanged end of tube to HPC rear case handtight only.

(h)Secure tube to bracket at No. 21 fuel injector with clamp, bolt, threads lubricated with Engine Oil (Material No.P03-001), and nut. TORQUE clamp, bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(i)TORQUE tube bolts securing tube to the diffuser case to between 65 and 85 lbf.in. (0.74 and 0.96 m.daN), then without loosening, retorque to required limit until proper torque is maintained. Secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292).

(j)TORQUE bolts securing tube flange and bracket to HPC rear case to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN) then retorque to same limit without loosening until torque is maintained and secure with Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the bolts.

(k)Secure PT4.95 tube and air shutoff valve signal tube to bracket at flanged end of vent tube with clamps, bolts, threads lubricated with Engine Oil (Material No.P03-001), and nuts. TORQUE clamp bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

**ON A/C 101-200,

D. Close-Up and Test

(1)If turbine vane cooling air duct, (lower right) was removed for access to fuel injector 7, install duct (Ref. 75-23-02, P. Block 401).

(2)If turbine vane cooling air duct (upper left) was removed for access to fuel injector 20, install duct (Ref. 75-23-02, P. Block 401).

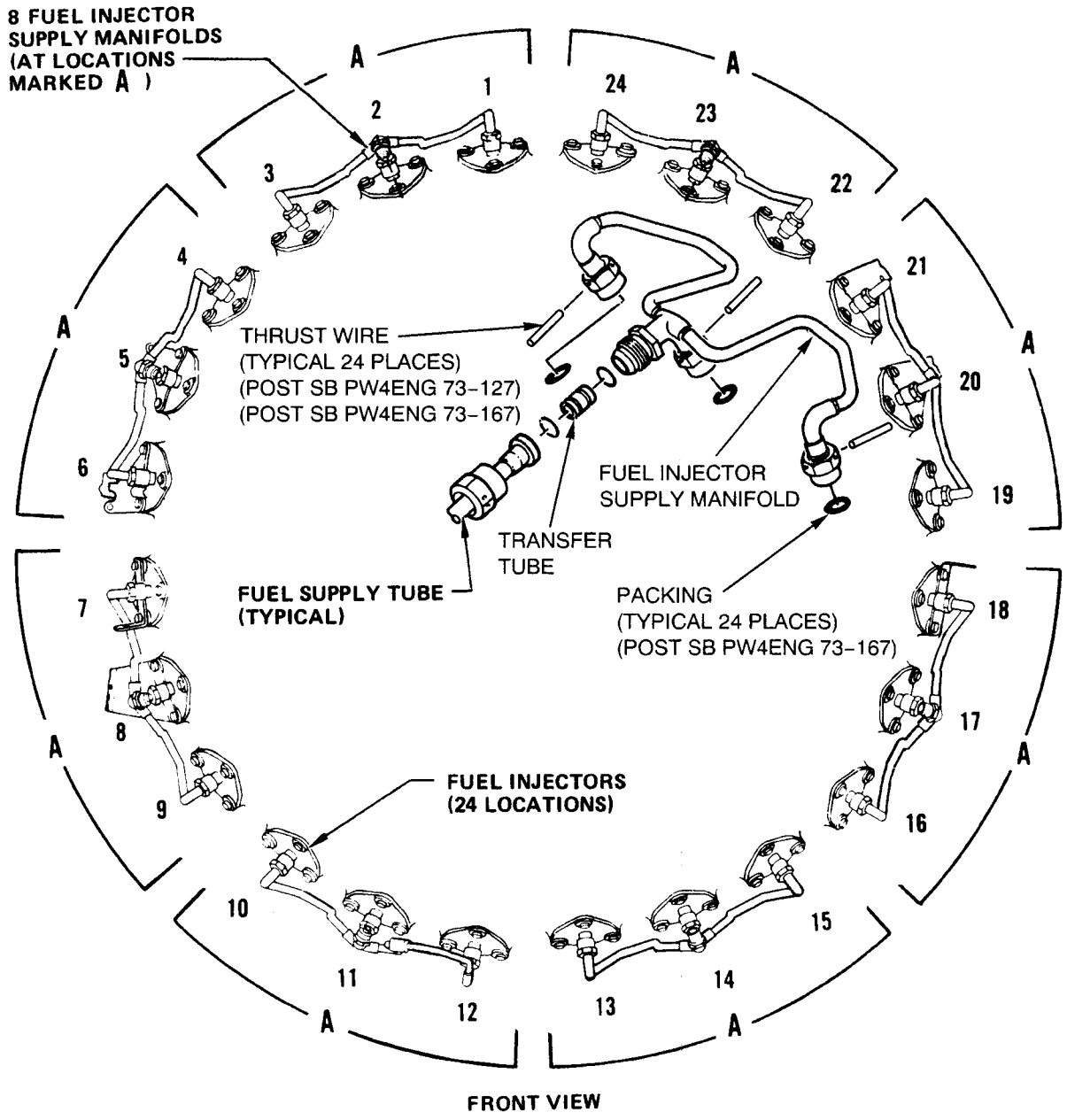
(3)If 15th stage bleed manifold and pylon drain tube were removed for access to fuel injector 19, install manifold (Ref. 36-11-00, P. Block 401) and drain tube (Ref. 71-70-51, P. Block 401).

(4)If oil tank was removed to gain access to fuel injectors 16 and 17, install oil tank (Ref. 79-11-00, P. Block 401).

(5)If TCC duct assembly was removed for access to fuel injector 5, install duct (Ref. 75-23-12, P. Block 401).

(6)If heat shield was removed to gain access to fuel injectors 9 and 10, attach right hydraulic pump heat shield to mounting brackets with bolts. TORQUE bolts to between 75 and 85 lbf.in. (0.85 and 0.96 m.daN).

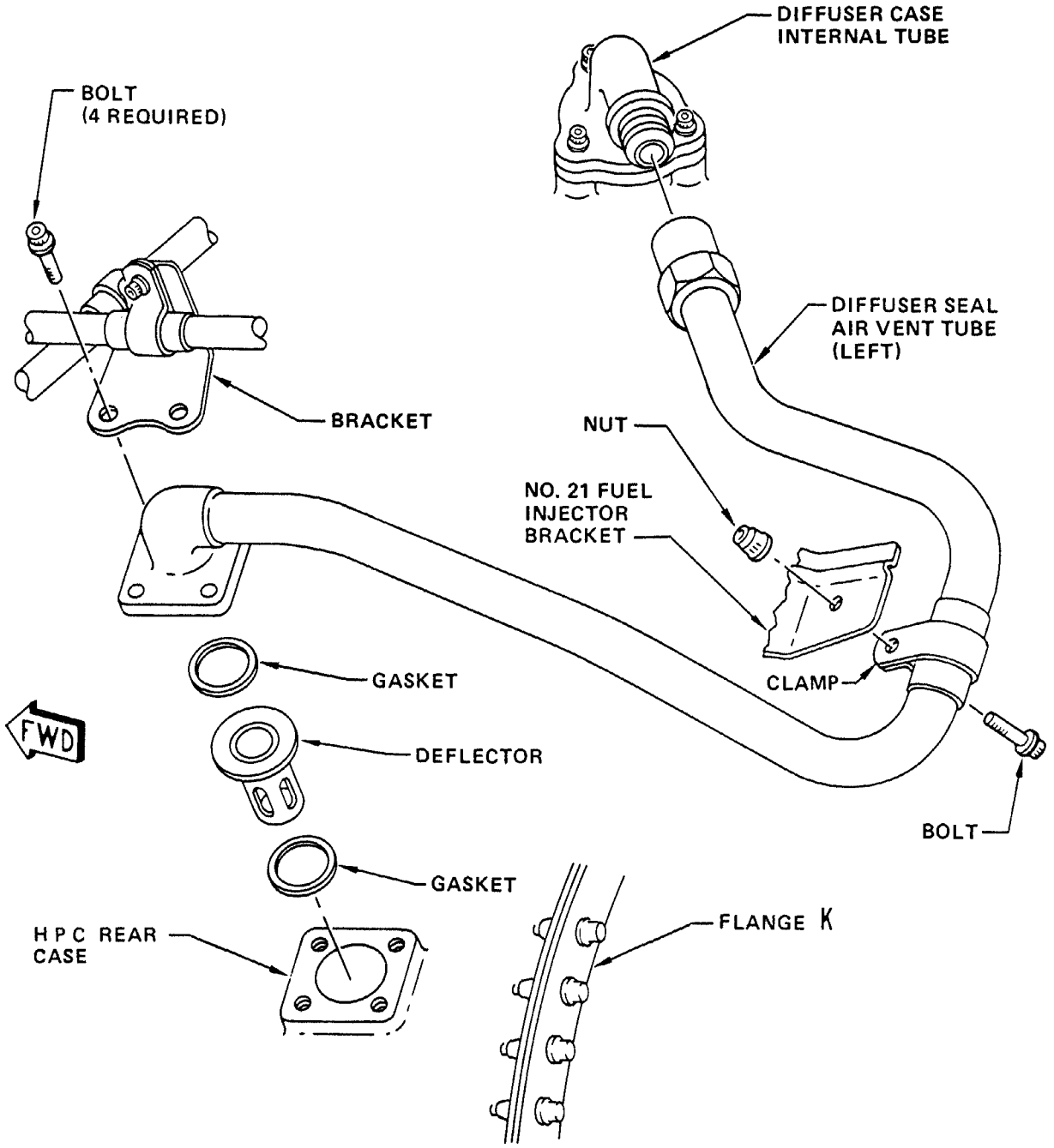
(7)If pneumatic starter was removed to gain access to fuel injectors 11 and



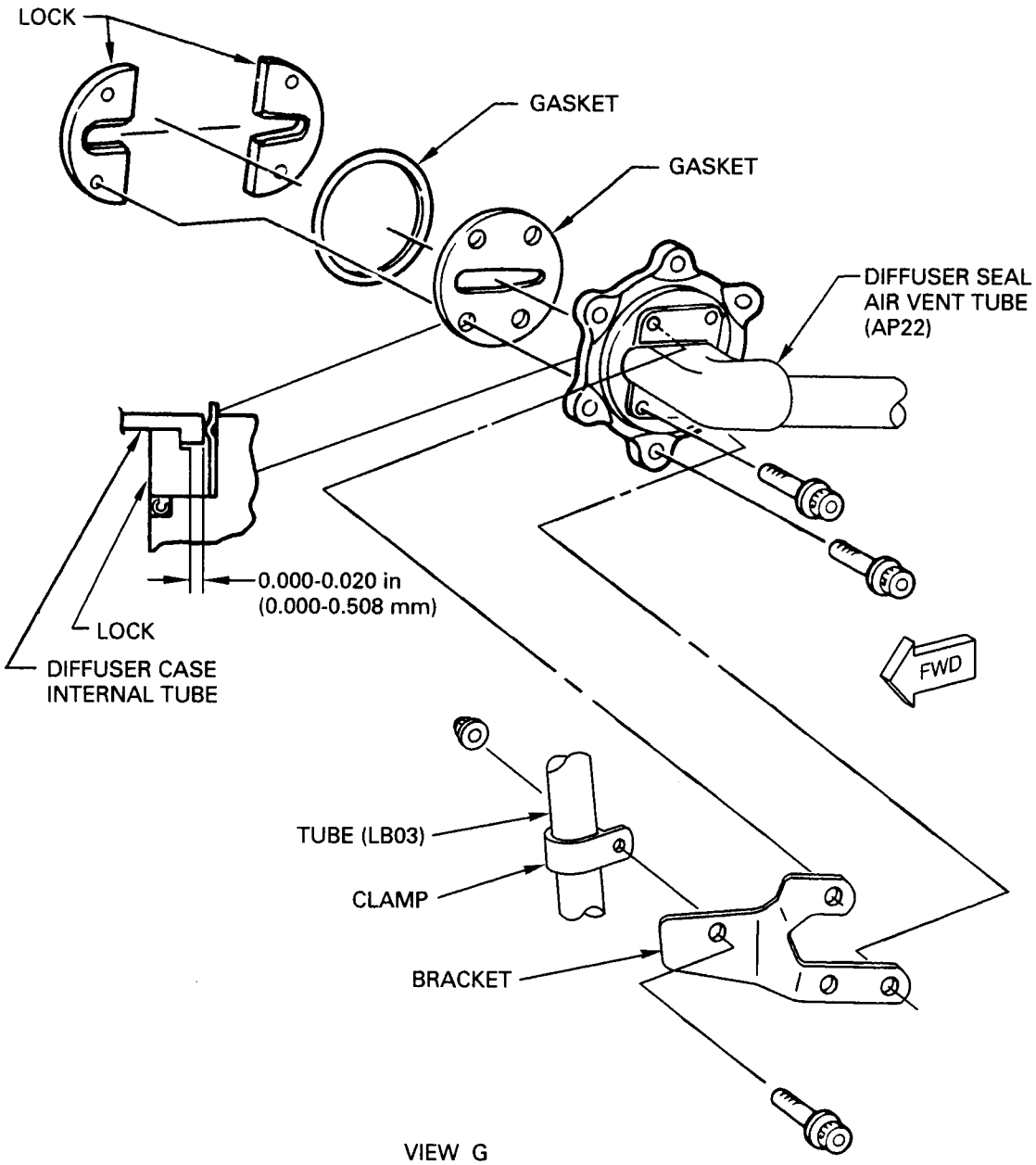
L-A4268 (0996)

BM5 73 13 06 4 KAM0 01

Fuel Injectors and Supply Manifolds Locations
Figure 401



Diffuser Seal Air Vent Tube (AP22) (Left)
(for Access to Fuel Injector No. 22)
Figure 402

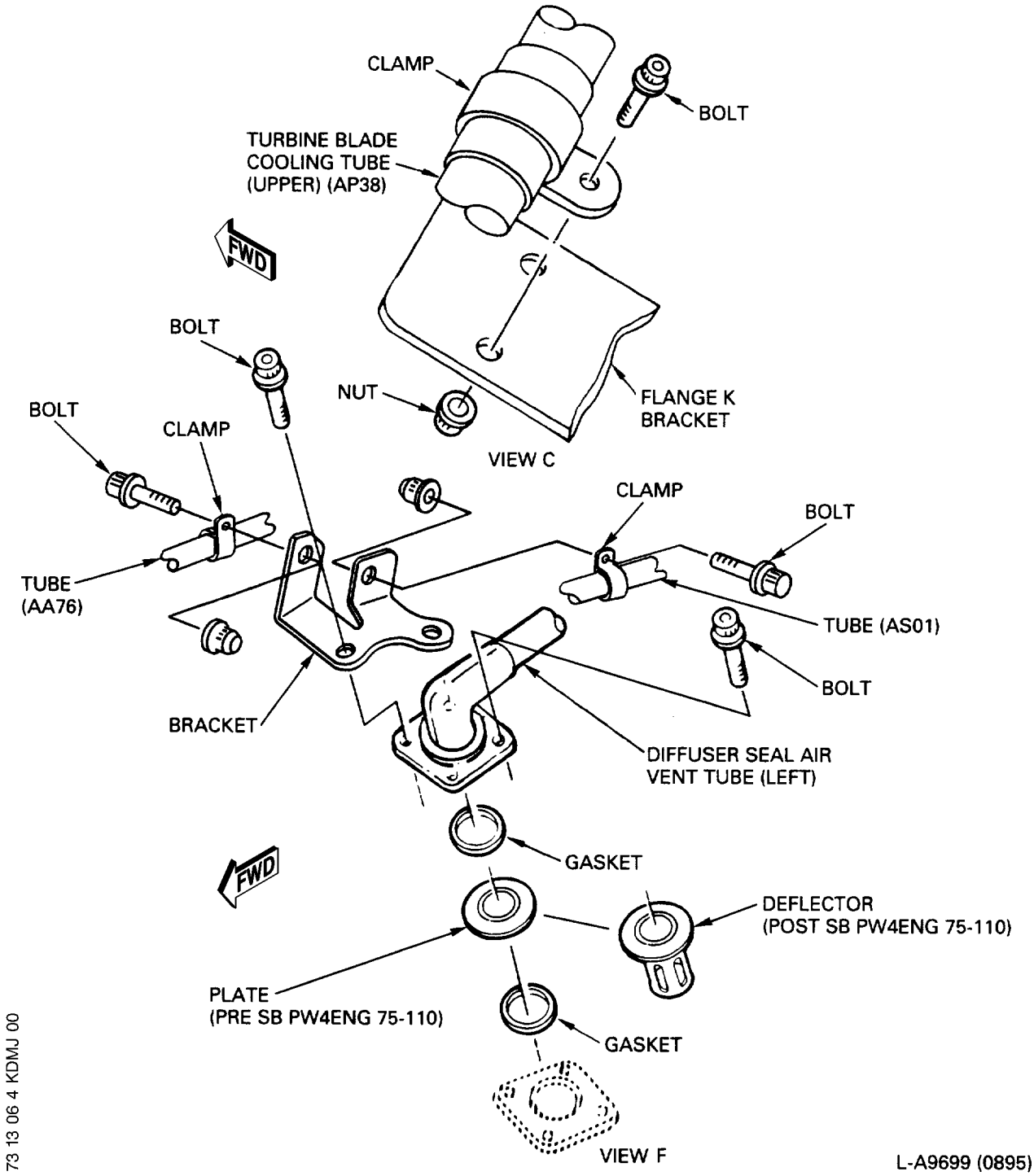


VIEW G

L-A8782 (0398)

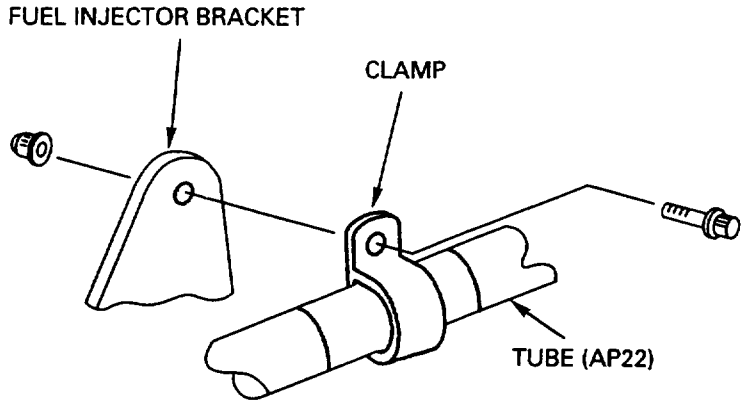
BM5 73 13 06 4 KDMA 01

Diffuser Seal Air Vent Tube (AP22) (Left)
(for Access to Fuel Injector No. 22) (Sheet 1)
Figure 403



BM5 73 13 06 4 KDMJ 00

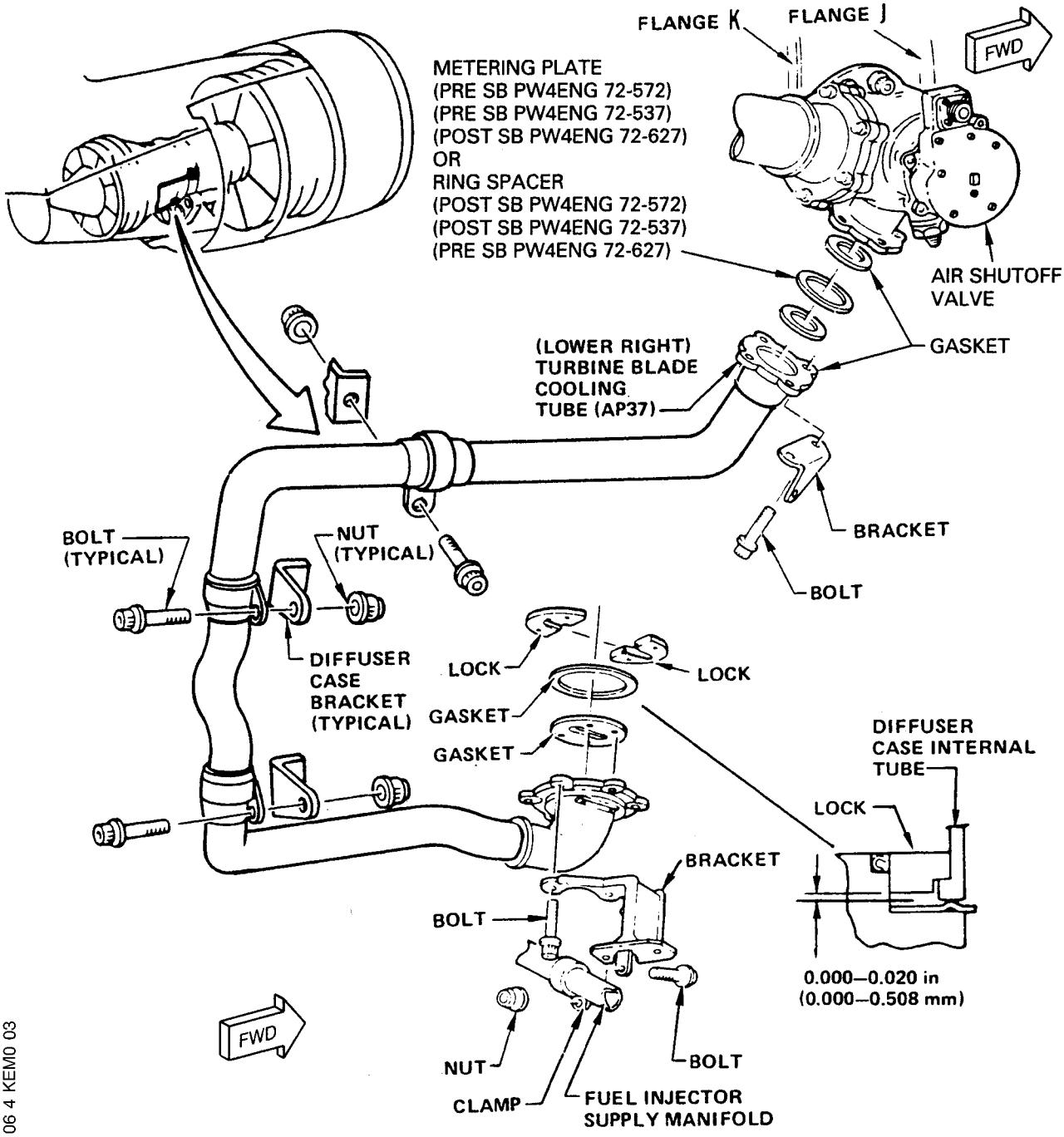
Diffuser Seal Air Vent Tube (AP22) (Left)
(for Access to Fuel Injector No. 22) (Sheet 2)
Figure 403



VIEW H

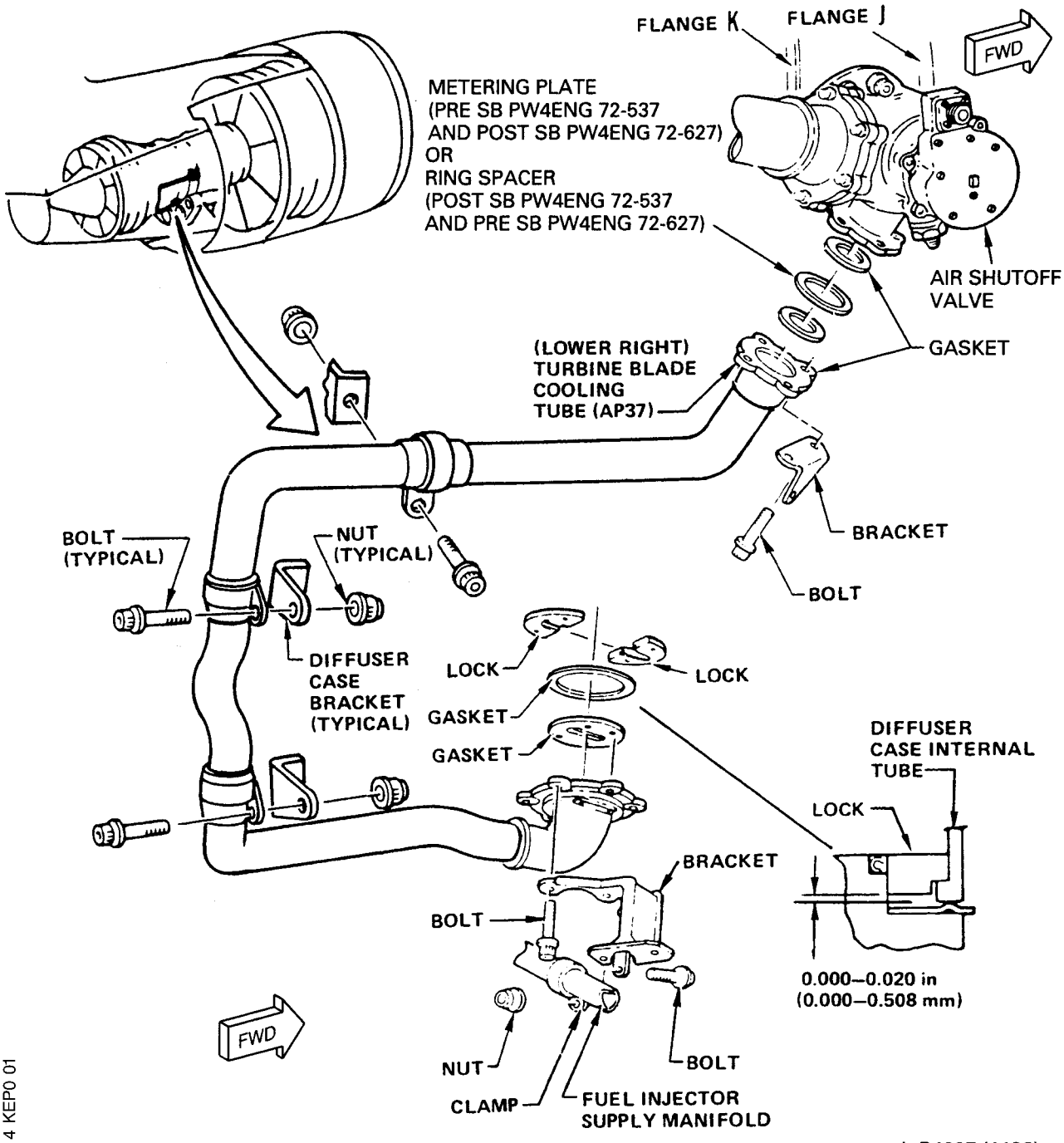
L-A8781 (0000)

Diffuser Seal Air Vent Tube (AP22) (Left)
(for Access to Fuel Injector No. 22) (Sheet 3)
Figure 403



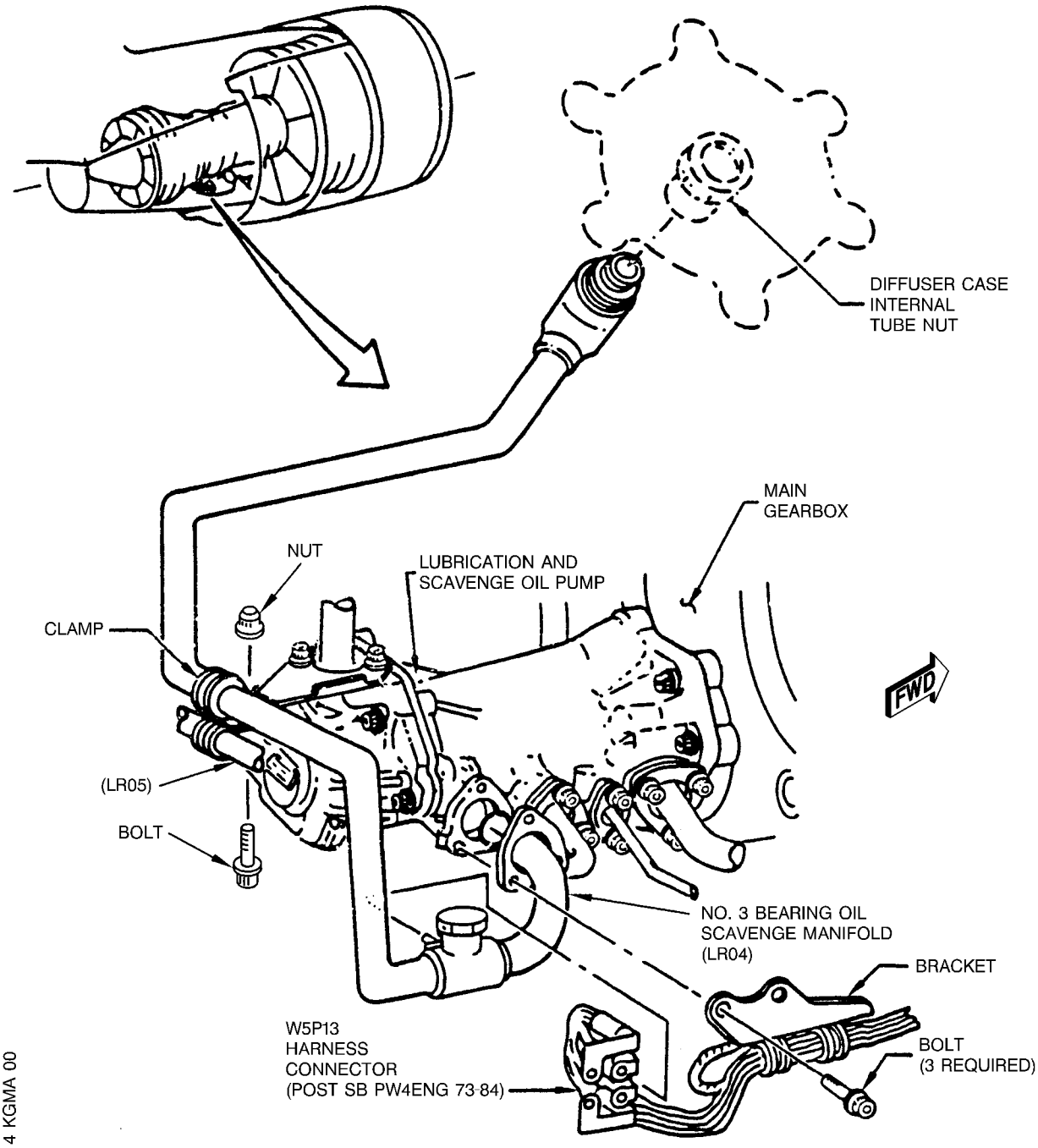
BM5 73 13 06 4 KEM0 03

Turbine Blade Cooling Air Tube (AP37) (Lower Right)
(for Access to Fuel Injector No. 12)
Figure 404



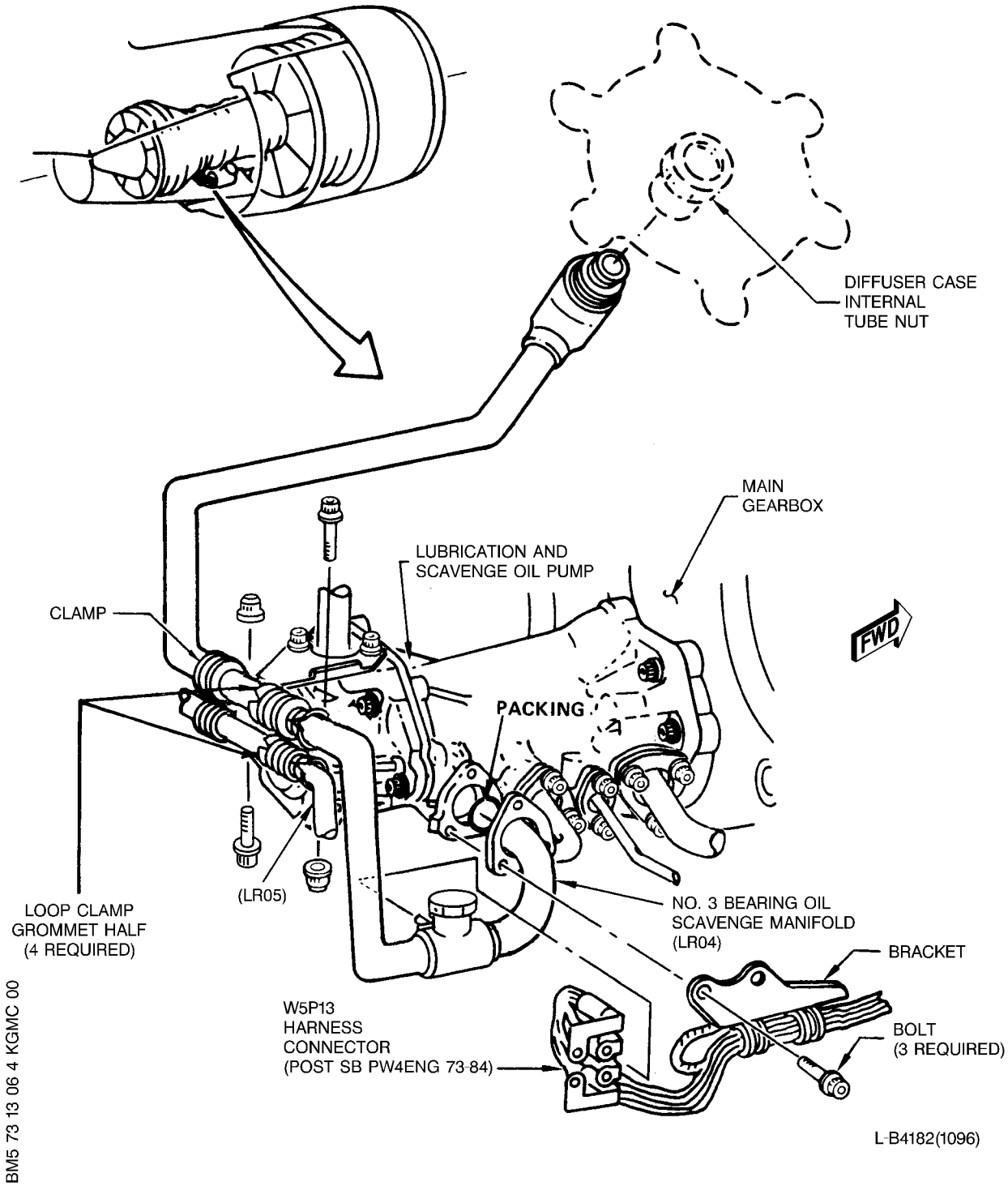
BM5 73 13 06 4 KEP0 01

Turbine Blade Cooling Air Tube (AP37) (Lower Right)
(for Access to Fuel Injector No. 12)
Figure 405

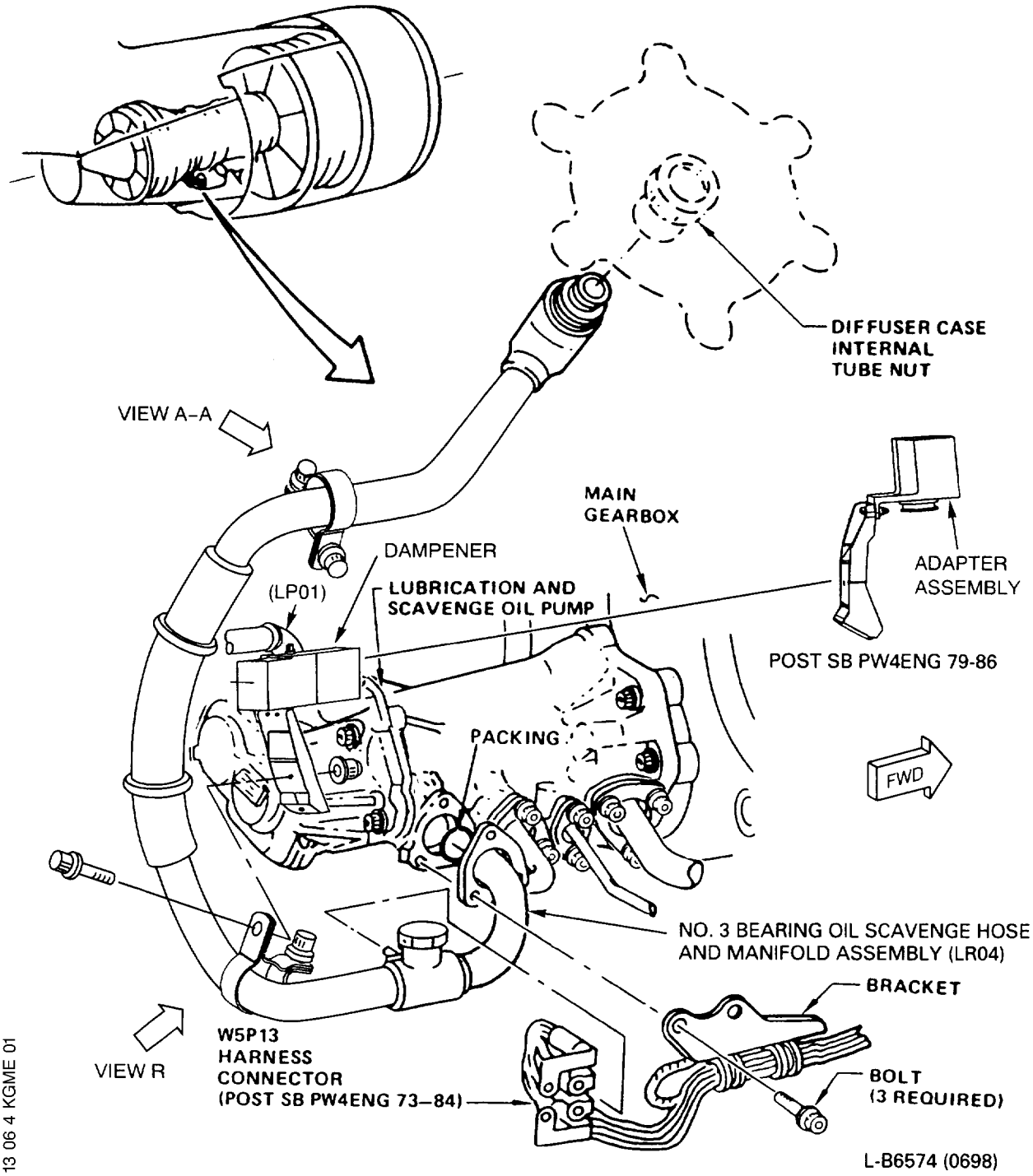


BM5 73 13 06 4 KGMA 00

No. 3 Bearing Oil Scavenge Manifold (Pre SB PW4 ENG 79-46)
(for Access to Fuel Injector No. 13) (Sheet 1/6)
Figure 406

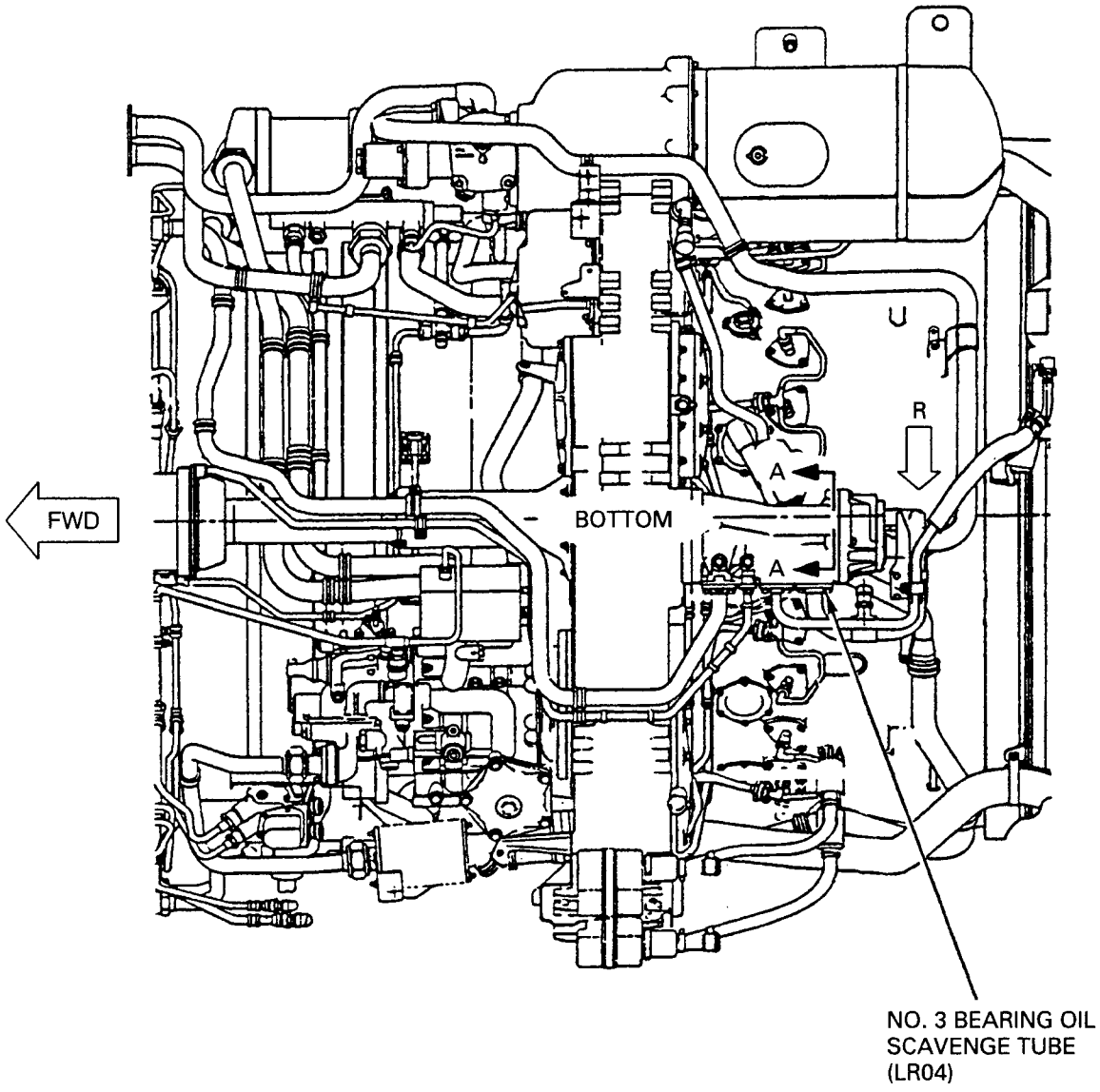


No. 3 Bearing Oil Scavenge Manifold (Post SB PW4ENG 79-46 and Pre SB PW4ENG 79-75) (for Access to F.I. No. 13) (Sheet 2/6)
Figure 406



BM5 73 13 06 4 KGME 01

No. 3 Bearing Oil Scavenge Manifold (Post SB PW4 ENG 79-75)
(for Access to Fuel Injector No. 13) (Sheet 3/6)
Figure 406

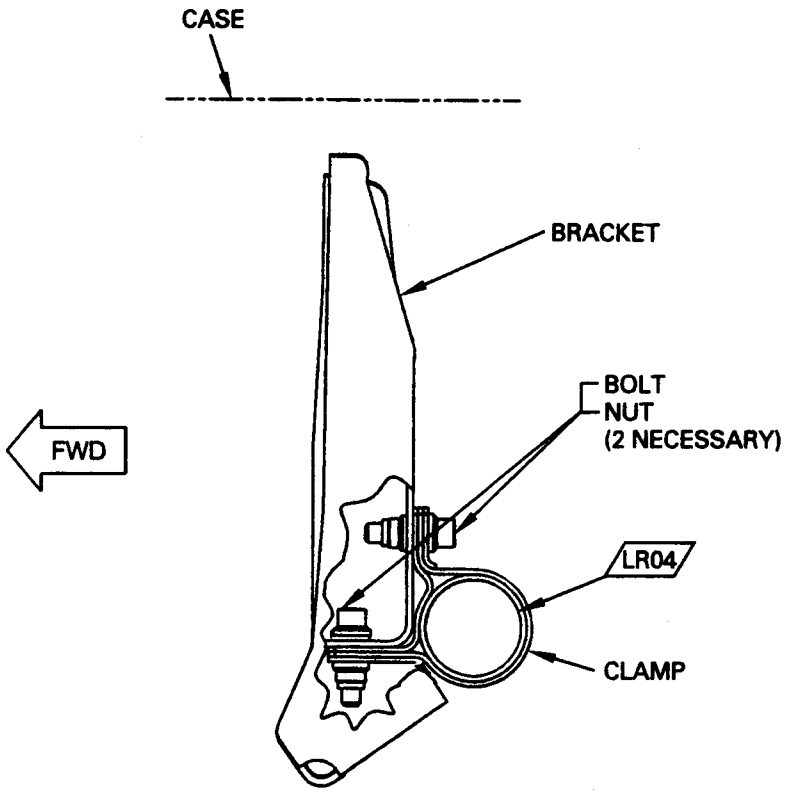


ENGINE BOTTOM VIEW

L-B2517 (0000)

BM5 73 13 06 4 KGMG 00

No. 3 Bearing Oil Scavenge Manifold (Post SB PW4 ENG 79-75)
(for Access to Fuel Injector No. 13) (Sheet 4/6)
Figure 406

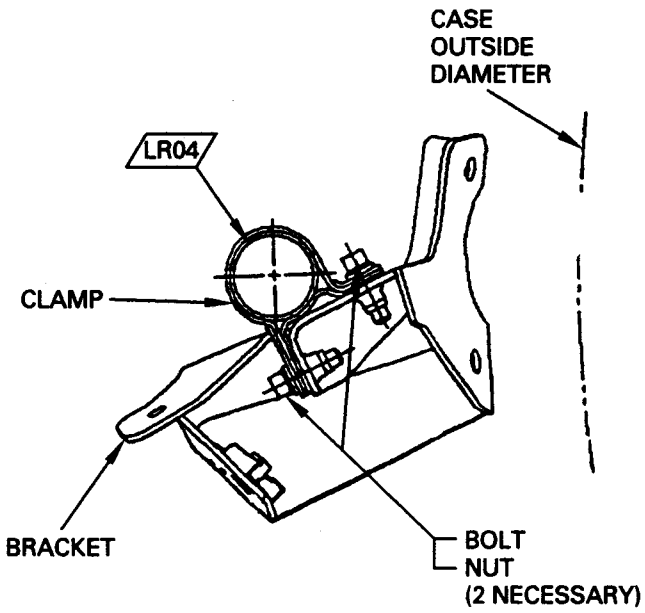


VIEW R

L-B2520 (0000)

BM5 73 13 06 4 KGMJ 00

No. 3 Bearing Oil Scavenge Manifold (Post SB PW4 ENG 79-75)
(for Access to Fuel Injector No. 13) (Sheet 5/6)
Figure 406

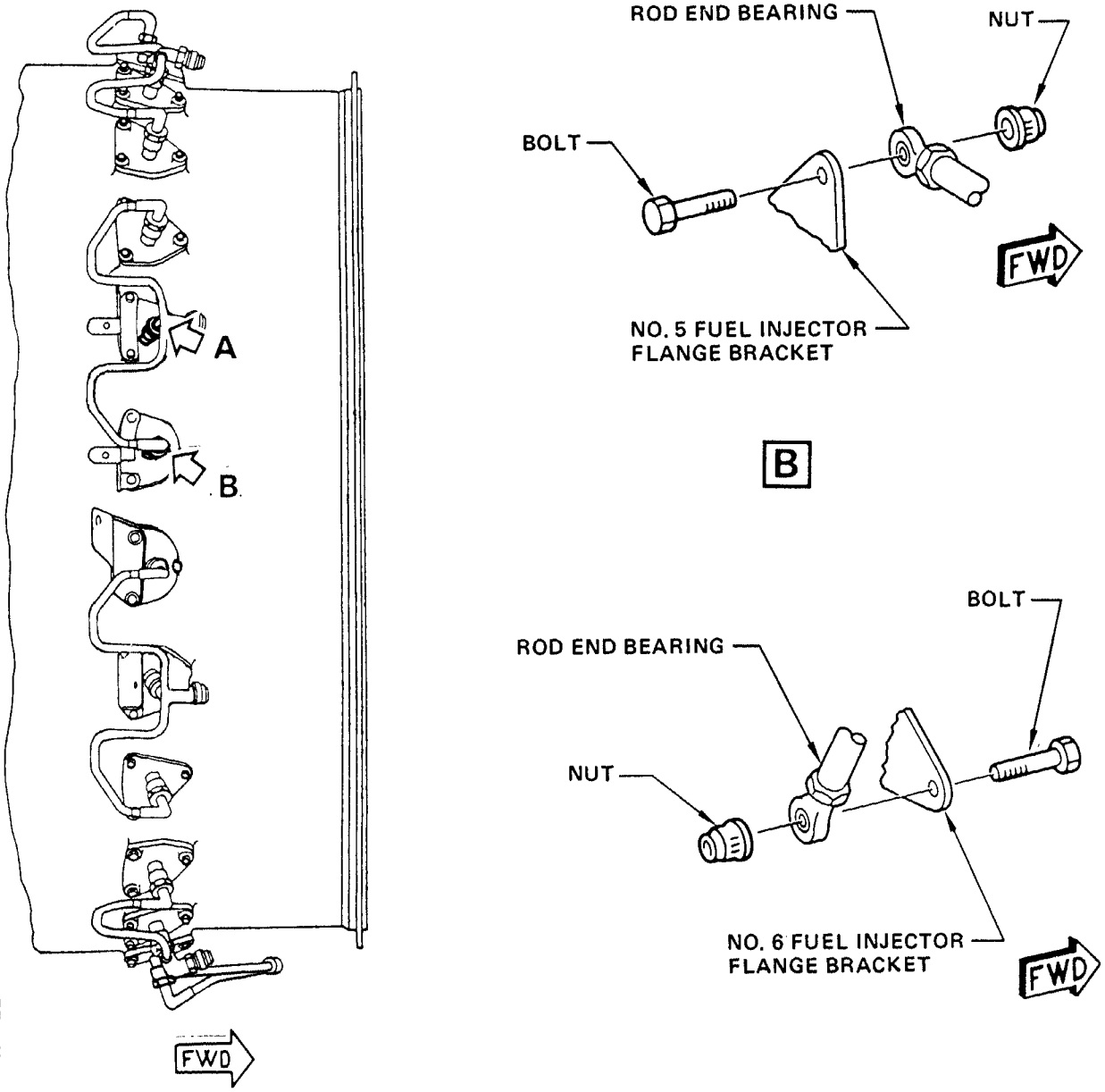


VIEW A-A

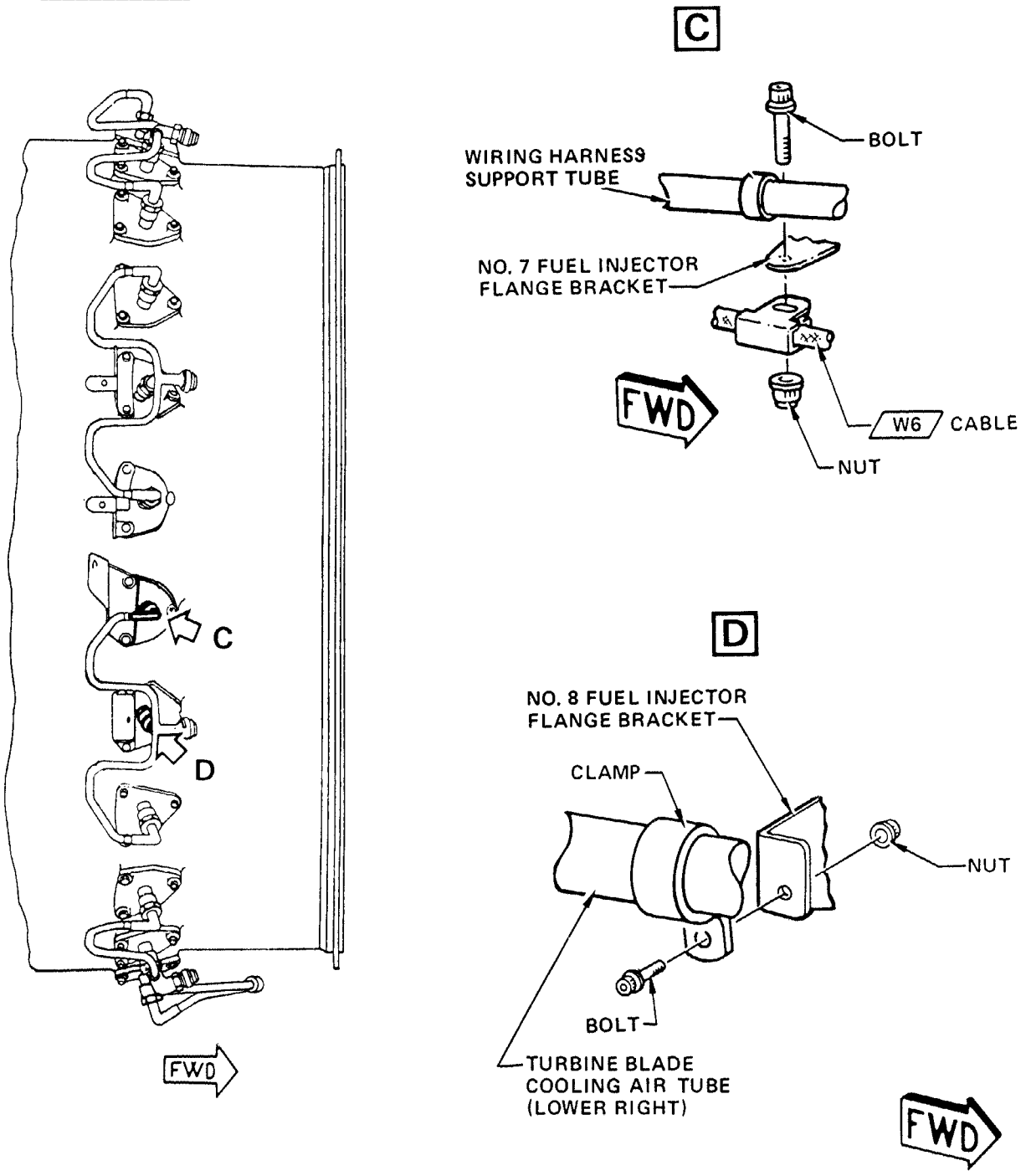
L-B2519 (0000)

BM5 73 13 06 4 KGML 00

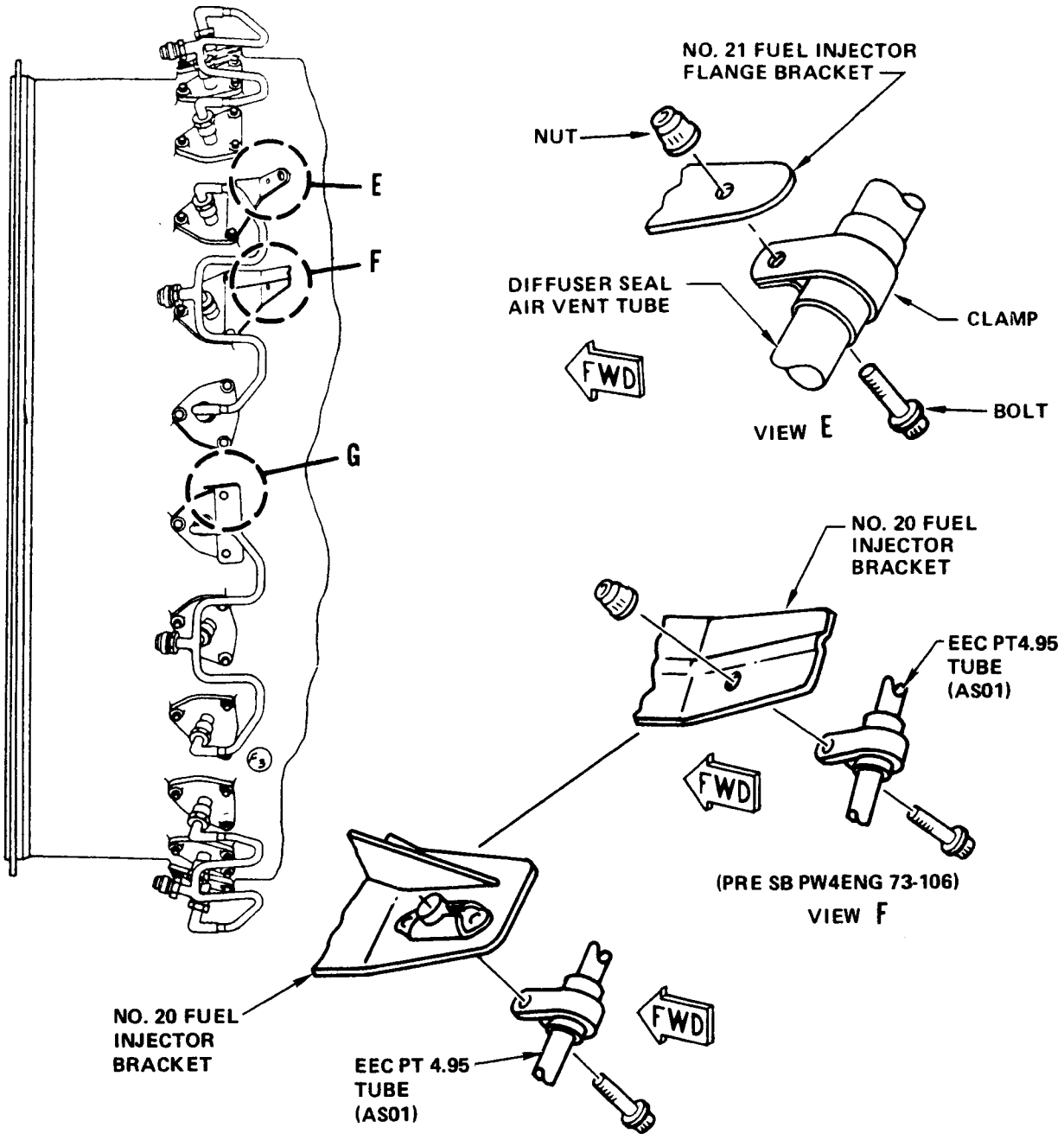
No. 3 Bearing Oil Scavenge Manifold (Post SB PW4 ENG 79-75)
(for Access to Fuel Injector No. 13) (Sheet 6/6)
Figure 406



Fuel Injector Flange Brackets and Clamping
(Right Side) (Sheet 1/4)
Figure 407

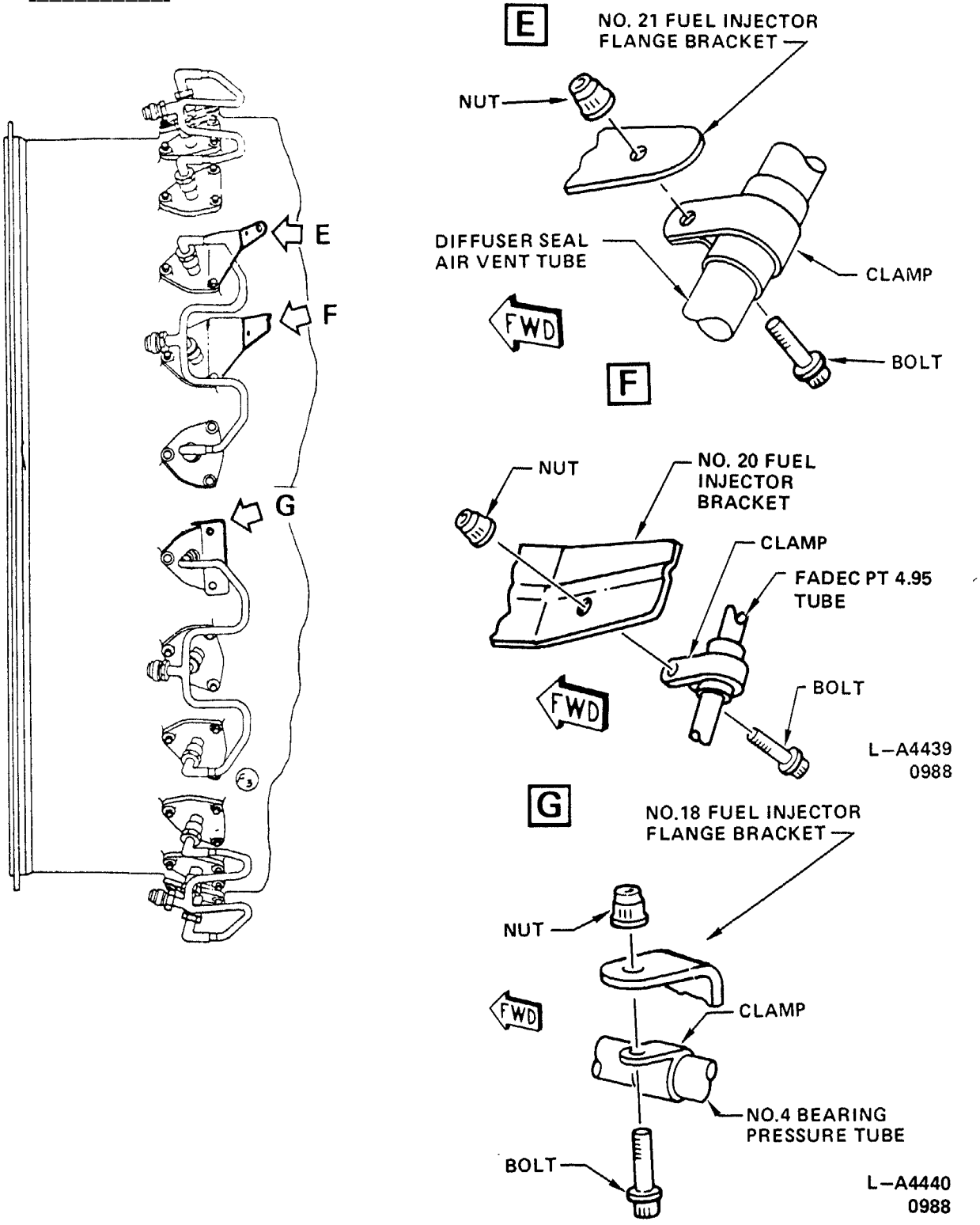


Fuel Injector Flange Brackets and Clamping
(Right Side) (Sheet 2/4)
Figure 407



BM5 73 13 06 4 KJMD 00

Fuel Injector Flange Brackets and Clamping
(Left Side) (Sheet 3/4)
Figure 407



BM5 73 13 06 4 KJME - 27 - 22
DM5

Fuel Injector Flange Brackets and Clamping
(Left Side) (Sheet 4/4)
Figure 407

12, install pneumatic starter (Ref. 80-13-01, P. Block 401).

(8) If IDG and heat shield were removed to gain access to fuel injectors 13, 14, and 15, attach integrated drive generator (IDG) heat shield to mounting brackets with bolts. TORQUE bolts to between 75 and 85 lbf.in. (0.85 and 0.96 m.daN). Install IDG (Ref. 24-11-11, P. Block 401).

(9) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(10) Remove access platform.

(11) Close thrust reverser and fan cowl doors, and remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

(12) Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

FUEL/OIL COOLER - DESCRIPTION AND OPERATION

1. Fuel/Oil Cooler (Ref. Fig. 001)

A. Purpose

The fuel/oil cooler and associated bypass valve, mounted on the HPC rear case at 8:00 position is used to :

- Heat fuel pump filter inlet fuel to automatically prevent fuel system icing
- Cool engine and IDGS oil
- Prevent excessive fuel temperature.

B. Description and Operation

- The fuel/oil cooler in a single housing contains separate engine oil flow and IDGS oil flow cooler cores that share a common internal fuel flow passage.
- The IDGS oil flow and fuel flow are continuous. The engine oil flow is controlled by the fuel/oil cooler bypass valve and is bypassed to prevent excessive fuel pump filter outlet fuel temperature.
- A pressure relief valve in the IDGS cooler core allow fuel pump boost stage output to bypass the IDGS core and flow only through the engine core in the event of an IDGS cooler core blockage.
- Three oberboard ports drain internal fuel and/or oil leakage overboard. (No leakage is permitted).
- The fuel/oil cooler bypass valve is FADEC controlled, solenoid operated, servo (engine pressure oil) actuated valve. When the FADEC energizes the solenoid with 28VDC it causes the engine oil to bypass the cooler core.

2. Fuel Bypass Valve (Ref. Fig. 002)

A. Purpose

- The fuel bypass valve, mounted on the lower left side of the fuel pump, is used to prevent excessive fuel and oil temperatures at high metered fuel flow conditions.

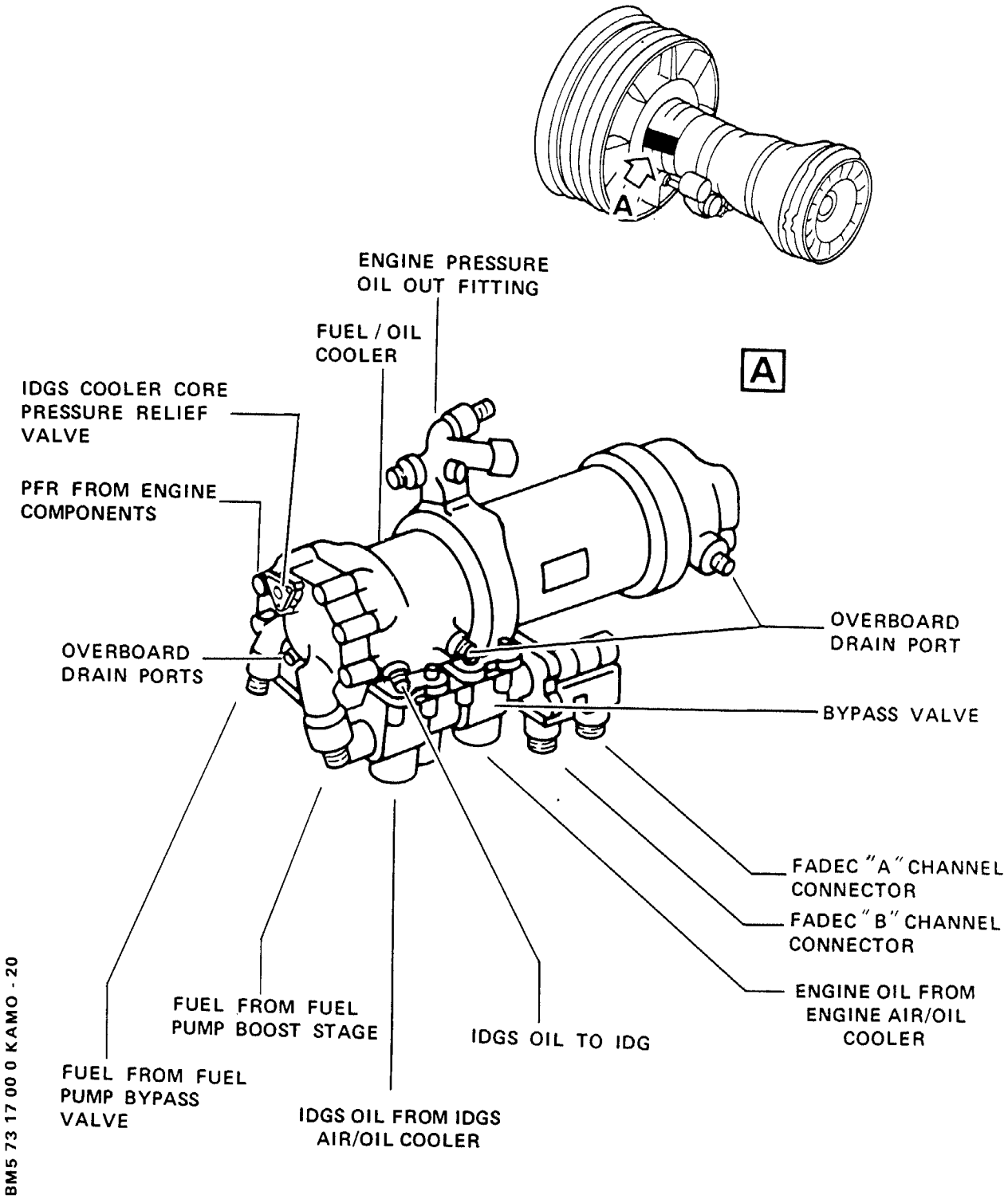
At high speeds, the fuel metering unit bypass fuel is diverted from the IDG portion of the cooler. At lower speeds, the bypassed fuel is channelled to both the IDG and engine oil sections of the cooler.

B. Description and Operation

- The fuel bypass valve is FMU controlled, servo (fuel pressure) actuated valve.

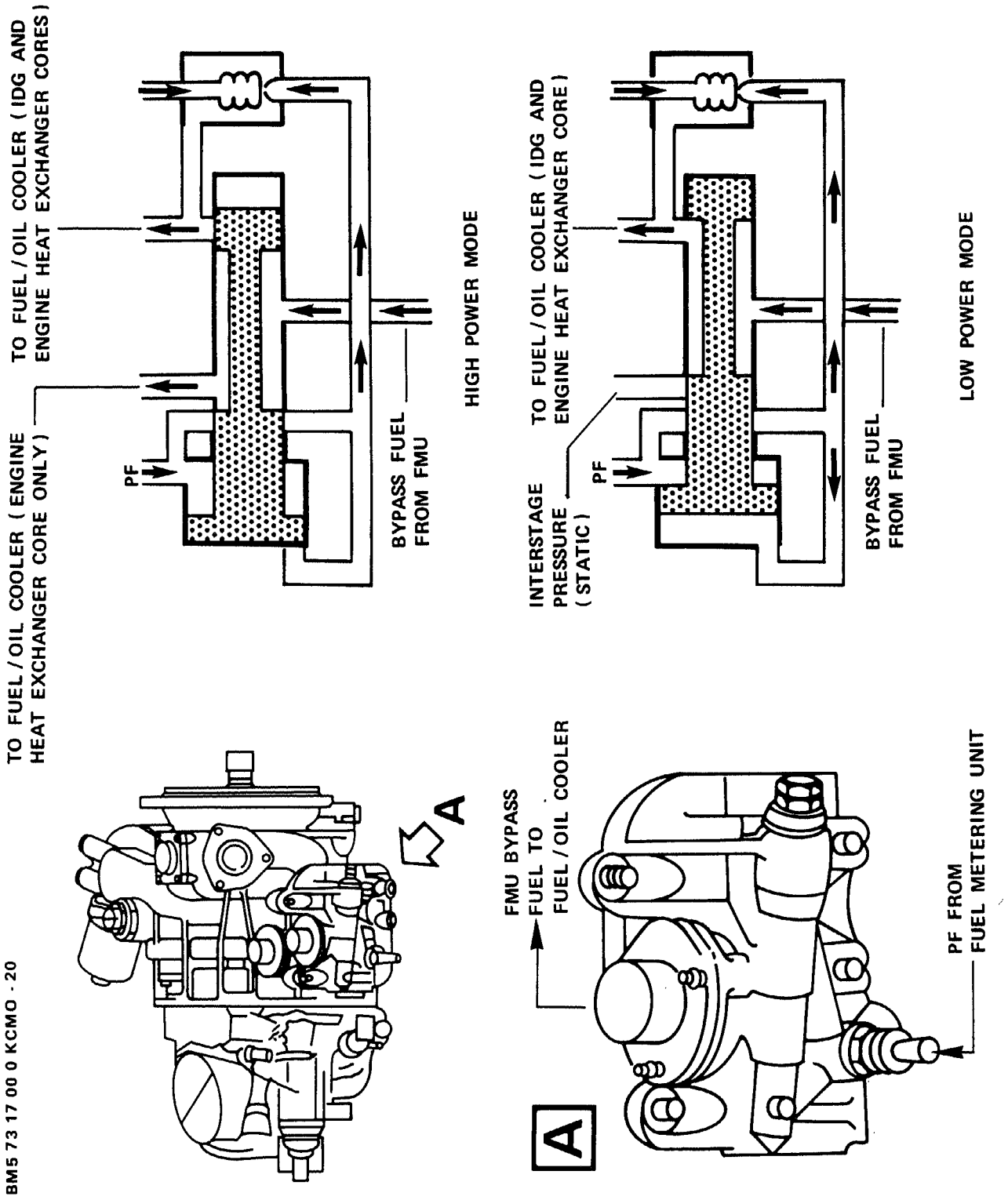
Valve actuation point determined by FMU bypass pressure vs fuel pump inlet pressure.

- At low engine power, less than 70 percent N2, the low pressure differential causes the FMU bypass fuel to join the fuel pump boost stage output and flow through the IDGS and engine fuel/oil cooler cores.
- At high engine power, greater than 83 percent N2, the high pressure differential causes the hot FMU bypass fuel to be diverted by the fuel bypass valve and it flows only through the engine fuel/oil cooler core. This prevents the IDGS oil temperature from affecting the engine fuel and oil temperatures during high power operation.


A
ENGINE PRESSURE OIL OUT FITTING
FUEL / OIL COOLER
A
IDGS COOLER CORE PRESSURE RELIEF VALVE
PFR FROM ENGINE COMPONENTS
OVERBOARD DRAIN PORTS
OVERBOARD DRAIN PORT
BYPASS VALVE
FADEC "A" CHANNEL CONNECTOR
FADEC "B" CHANNEL CONNECTOR
ENGINE OIL FROM ENGINE AIR/OIL COOLER
FUEL FROM FUEL PUMP BOOST STAGE
IDGS OIL TO IDG
FUEL FROM FUEL PUMP BYPASS VALVE
IDGS OIL FROM IDGS AIR/OIL COOLER
BM5 73 17 00 0 KAMO - 20

Fuel/Oil Cooler and Bypass Valve
Figure 001

- The fuel bypass valve is a line maintenance replaceable component.


TO FUEL/OIL COOLER (IDG AND ENGINE HEAT EXCHANGER CORES)
TO FUEL/OIL COOLER (ENGINE HEAT EXCHANGER CORE ONLY)
PF
BYPASS FUEL FROM FMU
HIGH POWER MODE
TO FUEL/OIL COOLER (IDG AND ENGINE HEAT EXCHANGER CORE)
INTERSTAGE PRESSURE (STATIC)
PF
BYPASS FUEL FROM FMU
LOW POWER MODE
A
FMU BYPASS FUEL TO FUEL/OIL COOLER
PF FROM FUEL METERING UNIT
A
BM5 73 17 00 0 KCMO · 20

Fuel Bypass Valve
Figure 002

CONTROLLING - DESCRIPTION AND OPERATION

1. FADEC

The electronic engine control (EEC) is a full authority, dual channel, digital electronic control (FADEC). The FADEC interfaces with the airframe and engine control system components. The FADEC is a vibration isolated unit, mounted on the engine fan case, and cooled by natural convection. The control incorporates dual electronic channels, each with its own processor, power supply, program memory, and input/output capability. Power to each control channel is provided by a dedicated, engine gearbox-driven alternator. All essential control system input sensors and output actuators are also dual channel. This redundancy provides high operational reliability.

2. FADEC System Interface with Airframe

The electronic control uses digital data links to communicate with the systems. Each control channel has data links which are used to receive data from the airframe systems. Altitude, total pressure, total temperature and system discrete signals are used to calculate the appropriate engine ratings for flight conditions. The control transmits engine performance, rating, and status information on a digital data link to the airframe. The flight compartment display system, thrust management system and engine condition monitoring are users of the control supplied data.
N1 and N2 indications are provided via dedicated analog signal links.
The aircraft 28VDC supplies power to electronic control actuated solenoids which control the turbine cooling air, oil bypass IDG air/oil cooler override solenoid, and rotor clearance control systems.
The fuel shut off system is maintained as a separate crew-operated override, independent of the electronic control system.

3. FADEC System Interface with Engine

The electronic control receives rotor speed, pressure and temperature signals from the engine sensors. The control uses these parameters, along with flight compartment throttle control lever position, and the airframe system digital data, to command outputs to the engine actuators.
FADEC alternator supplies power to the electronic control actuated solenoids that control the stability bleed, start bleed, and the overspeed protection systems.

4. Functions

In response to the pilots commanded thrust setting, the control provides acceleration and deceleration limiting during transient operation and control of engine variables during steady state operation. The electronic control outputs provide full range control of fuel flow, stator vane angle, inter-compressor bleed, air/oil cooler and turbine case cooling. In addition, the control commands the start bleed, turbine vane cooling air, oil by-pass, IDGS air valve, and compressor rotor clearance control systems. The FADEC also provides overspeed protection for the high and low rotor.
The electronic control issues output command signals in such a manner that either channel is able to control the engine. Redundant data are available to the channel in control via a serial crosstalk data link. If the channel is incapable of control, fault logic switches control to the other channel.

The Full Authority Digital Engine Control provides the following functions :

A. Control of engine variable during starting

B. Acceleration and deceleration limiting

C. Isochronous idle high-pressure rotor speed governing, altitude-bias burner pressure idle, anti-icing bias pressure requirement controlled by burner pressure loop

D. Automatic control of maximum and climb rated power (engine pressure ratio)

E. Control of thrust as a function of throttle control lever position and thrust reverser position

F. Stator vane scheduling as a function of corrected high rotor speed

G. Modulated control of the low-pressure compressor exit (2.5) bleed

H. Modulated active rotor clearance control as a function of high rotor speed speed and altitude

I. Modulated control of the air valve in an air/oil cooler system

J. Turbine cooling air as a function of high rotor speed and altitude

K. Start bleed control

L. Control of a bypass valve in the fuel/oil cooler

M. Control of the rotor clearance system as a function of high rotor speed and altitude

N. Control of the IDG-AOCV override solenoid in the air/oil cooler system

O. Structural limiting for :
. Rotor speeds
. Burner pressure

P. Overspeed protection for both rotors ; analog and digital protection is provided

5. Power Setting

The system provides simplified engine operation procedures either with or without the autothrottle. The control of pilot-selected thrust settings, coupled with thrust setting procedures and flight compartment displays provides an integrated system which greatly simplifies the task of thrust management. The FADEC system requires no trimming.
The FADEC system operates in response to the pilot command thrust settings as transmitted by the throttle control lever position. Engine fuel flow is commanded to establish the engine pressure ratio (EPR) required, the prime

thrust setting parameter. The engine control will override the engine pressure ratio control loop and adjust the fuel valve to maintain engine operation within limits on high and low rotor speed or burner pressure.
If the required resources are not available to operate in the **EPR** mode, the **FADEC** will automatically revert to the reversionary control mode that controls on **N1** rotor speed. The **FADEC** is designed to permit engine operation using **N1** as an alternate thrust setting parameter. The **FADEC** system is dispatchable when the reversionary mode of operation is selected.

R **NOTE** : Small throttle control lever movements near idle will cause a
R transient overshoot. This condition will cause the engine
R parameters to rise and then to return to idle. Throttle movements
R beyond this point will result in normal engine operation.

6. Fault Isolation and Identification

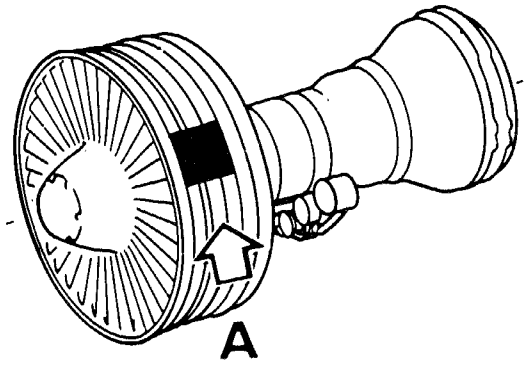
The **FADEC** system can accommodate both single and multiples failures with no loss in performance or operational capability. This is possible by use of redundancy on all critical functions, by detection of hardware and software faults, by validation test of each input and by logic which accommodates detected faults by reconfiguring the system to use redundant features.
Extensive self-test and fault isolation logic are built into the electronic engine control and exercised continuously. Self-test routines enhance on-wing troubleshooting and shop maintenance procedures. These provisions in the electronic engine control and in a readout device can detect and isolate faults within the **FADEC** system and its input and output devices. This aids the line mechanic in identifying and replacing the faulty line replaceable unit and also simplifies the shop maintenace process.
These information data are contained in the **FADEC** serial digital output buses.
In addition, each **FADEC** channel has a portion of it's Non-Volatile Memory reserved for fault data storage. The fault data stored in this memory can be retrieved via the **ARINC** output maintenance words during ground testing.

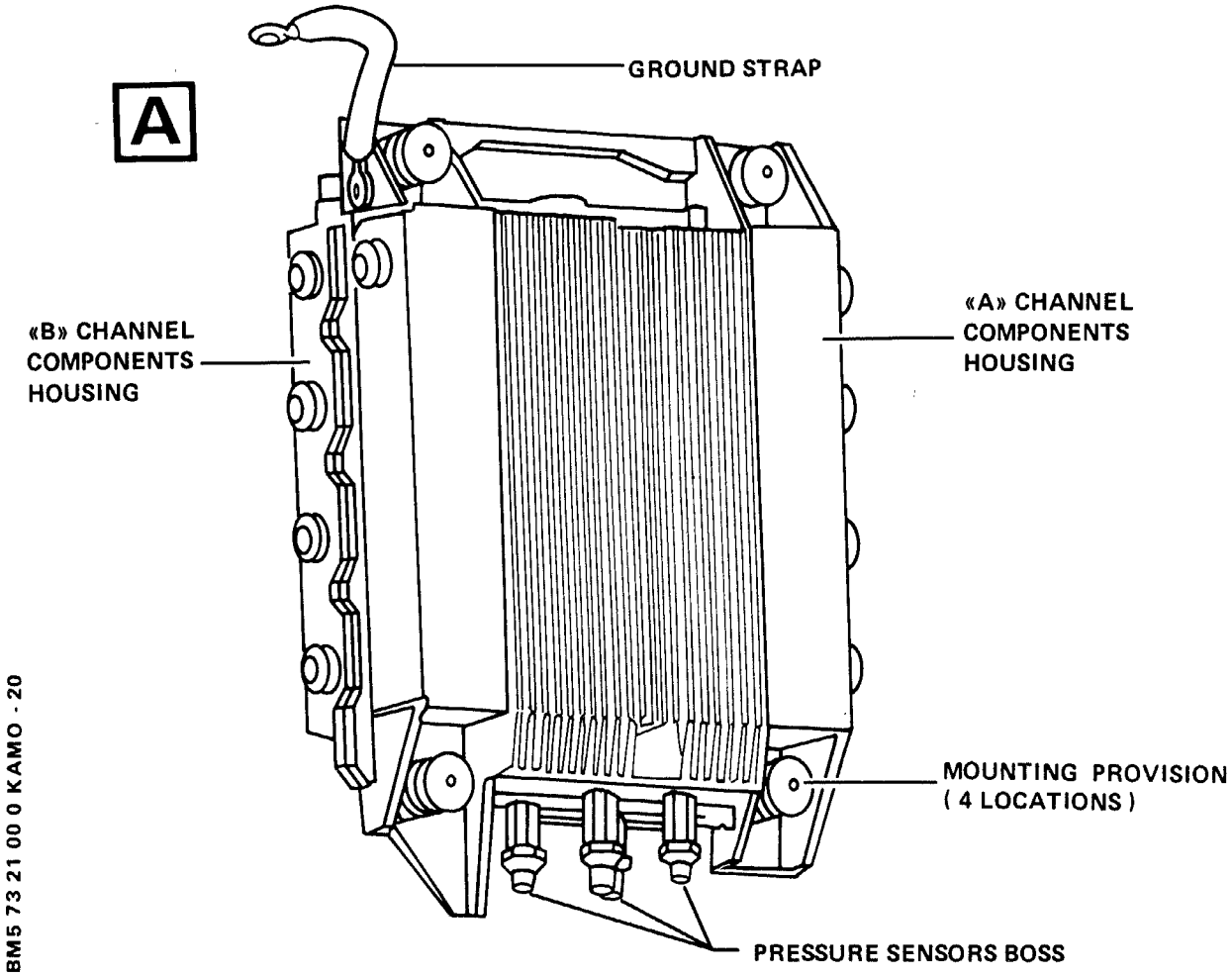
FUEL CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)
The Full Authority Digital Electronic Engine Control (EEC), is a vibration-isolated unit mounted on the engine fan case and cooled by natural convection. The FADEC assembly includes two independent control channels in one package. Each channelhas it own inputs, outputs and power supply. In addition to input/output redundancy, for comparison and redundance, data are crosstalked between the two channels via data link. The channel B assumes control if the channel A cannot command its output devices.
The control employs modular design and construction throughout. The dual channels are housed in one assembly, but are physically separated from one another through a unique two piece design. The housing separates into two major modules, each containing one control channel. Each housing half contains two printed circuit board modules, the input/output interconnect modules, and two mini-sensors with their own printed circuit boards. A partition divides the two halves to provide two separate, self-contained modules.
The other general characteristics of the FADEC are the following :
- five modulating control loops in each channel
- hardware overspeed protection
- 60K UV PROM memory, 2K RAM, 2K EEROM
- Total power 50 watts
- size : 13.5 X 18.6 X 4.35 in.
- weight : 27.5 pounds.

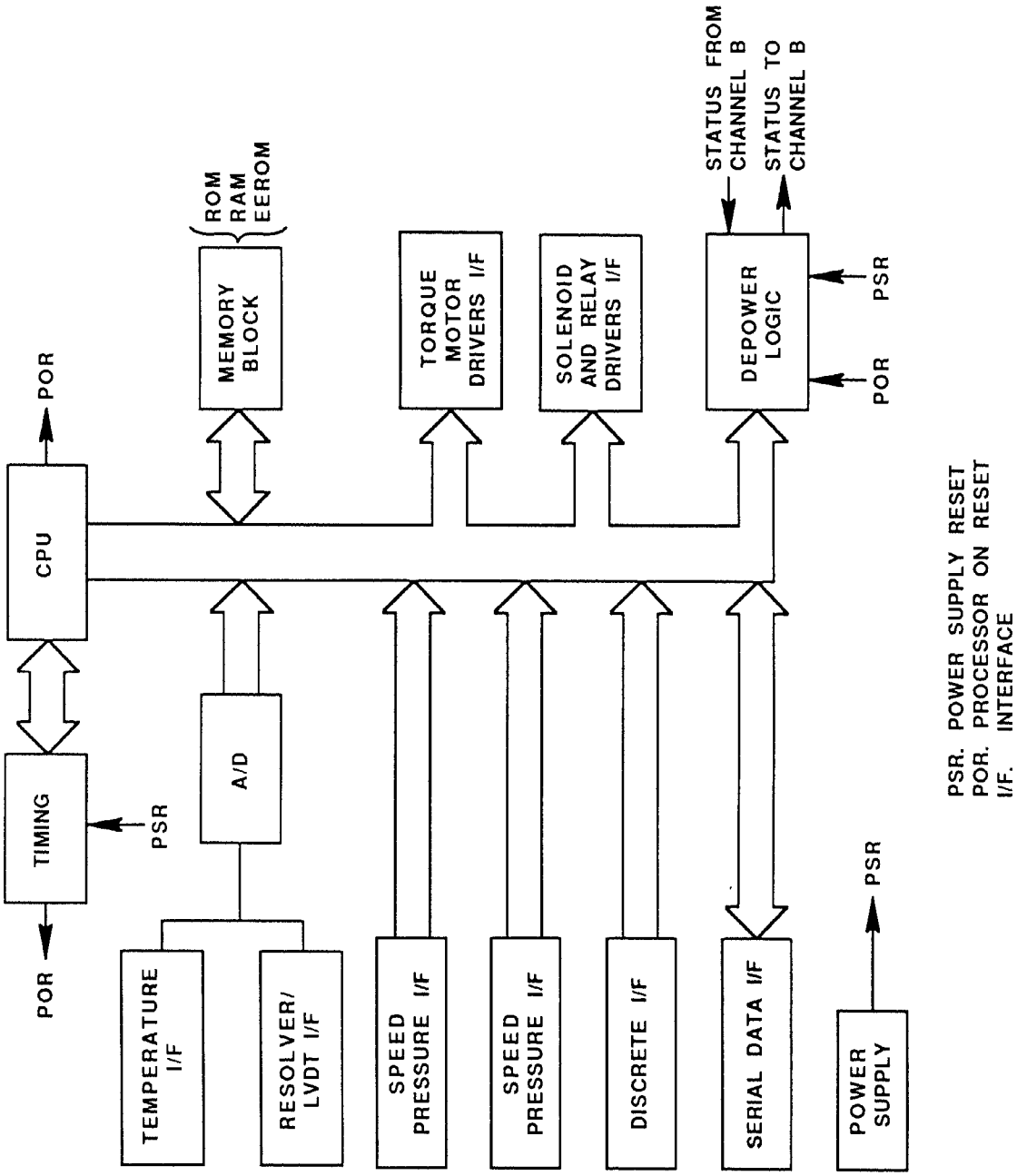
2. Processor and Memory (Ref. Fig. 002)
Each FADEC channel incorporates a 16 bit, parallel processor, up to 60K words of UV Programmable Read Only Memory (UVPROM), 2K words of Random Access Memory (RAM) and 2K words of Electrically Eraseable Read Only Memory (EEROM) of which 1K is used for pressure transducer calibration data, changed identification, and software schedule adjustments. The remaining 1K is used to record FADEC system faults for later retrieval to assist maintenance personnel in determining the proper maintenance action. The processors operate at a fixed clock frequency which is sufficient to perform all calculations at a rate which satisfies all control loop transient and stability requirements.
The processor is a low-power, high-performance device which utilizes state-of-the-art technology for all electrical components. It will operate with a basic instruction cycle time of 1.0 microsecond and will access memory with three full parallel busses : a 16 bit address bus, a 16-bit input bus, and a 16-bit output bus. A multilevel interrupt structure is implemented, as well as asynchronous serial communication, for external use during development.

3. Power Supply (Ref. Fig. 003)
The power supply section of the FADEC consists of the circuitry which conditions the alternator and aircraft input power for use by the various electronic circuits and their loads. Two identical supplies are provided, one for each channel.
Primary power for each channel is obtained from a dual-output permanent magnet alternator (PMA). The alternator power is converted to 30 volts direct current by a switching shunt regulator prior to further regulation to the va-




A
GROUND STRAP
«B» CHANNEL COMPONENTS HOUSING
«A» CHANNEL COMPONENTS HOUSING
MOUNTING PROVISION (4 LOCATIONS)
PRESSURE SENSORS BOSS
BM5 73 21 00 0 KAMO - 20

FADEC
Figure 001



BM5 73 21 00 0 KCMO - 19

System Block Diagram (Channel B Identical)
Figure 002

rious voltage levels required to operate the FADEC. Two aircraft generated 28 volt DC inputs are provided to each channel of the FADEC. One input is used to power various solenoids which are switched by the FADEC. The primary function of these solenoids is to enhance engine operating efficiency. As such, loss of the 28 volt power source is tolerable since engine operability is not affected.
The second 28 volt input is used to power the FADEC for test purposes when the engine is not running. This input is "diode OR'd" with the shunt regulated 30 volts output of the FADEC dedicated generator. With the engine shut down, the aircraft source powers the FADEC in the same manner as the dedicated generator.
This source is also used to power FADEC via Supplemental Control Unit (SCU) in case of Permanent Magnetic Alternator (PMA) failure with engine running.

4. Analog Inputs
Implementation of analog inputs to the FADEC is described below :

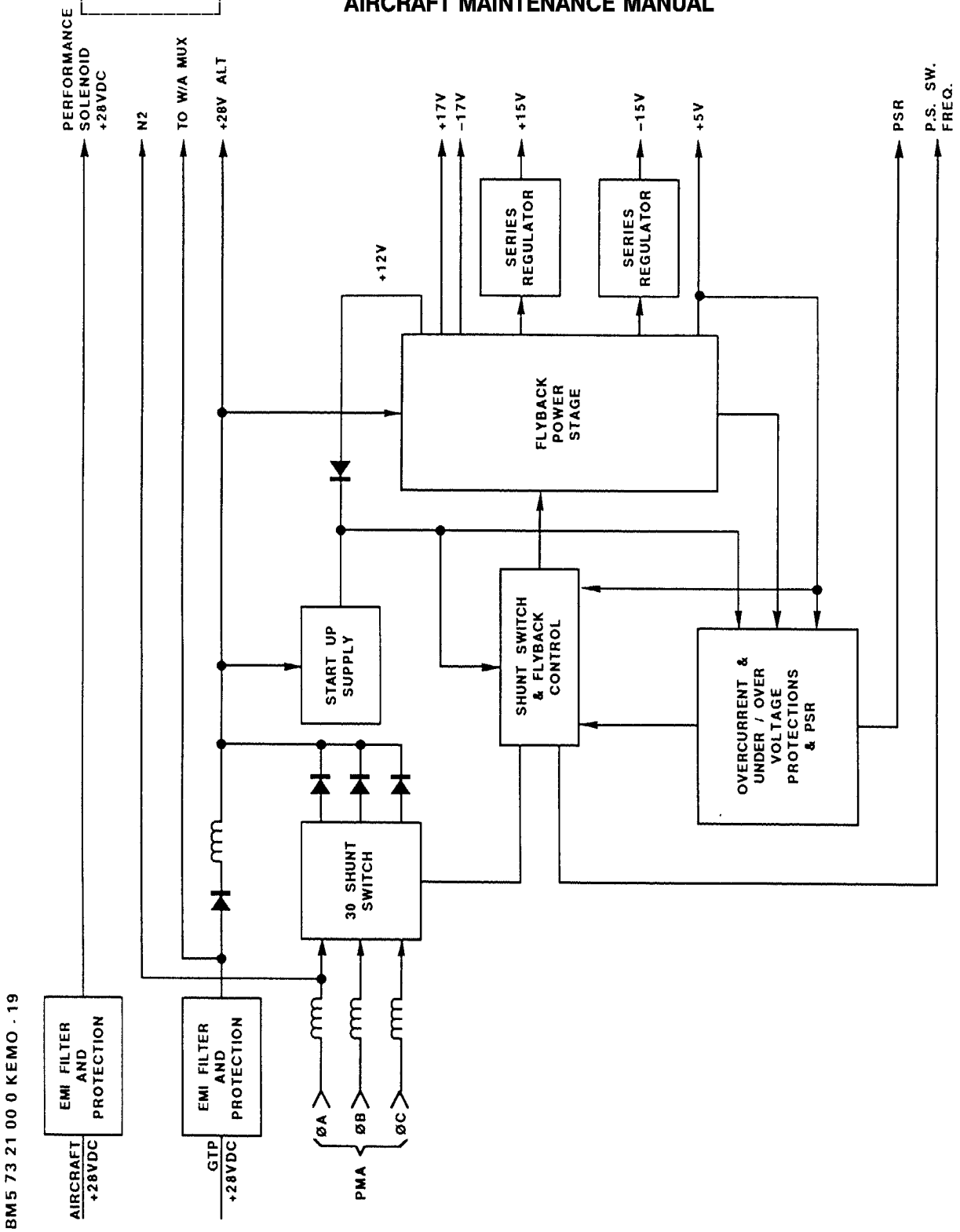
A. Thrust Lever Angle (TLA) is obtained directly from a dual transducer, located in the flight compartment. Each transducer, a resolver, is excited independently from the FADEC. Sine and cosine signals are rectified and converted into digital words, and the angle is determined by digital computation.

B. T2 is sensed by a platinum resistance sensor located in the engine inlet airstream. Precision direct current voltage excitation is provided by the FADEC. The sensor signal is converted into a digital word for use in the control mode calculations.

C. T5, T3, Toil and Tfuel are sensed by chromel-alumel thermocouples installed at engine station locations. The signals are compensated by cold junction circuitry located in the FADEC and then converted into digital words.

D. Feedback signals are provided by reduntant position transducers for the fuel flow (WF), stator vane angle (SVA), air/oil cooler, intercompressor (2.5) bleed and turbine case cooling loops. Excitation for each position transducer is provided by the FADEC. The return signals are then conditioned and converted into digital words for use in the control mode calculations.
Analog to digital converters have 15-bit resolution and 0.16 percent absolute accuracy.

5. Frequency Inputs
The FADEC senses high rotor speed (N2) by determining the frequency of the AC power supplied to it by a dual winding Permanent Magnet Alternator (PMA). The alternator is driven by the engine N2 gearbox.
The FADEC senses low rotor speed (N1) by determining the frequency of the alternating current voltage generated by a dual-coil magnetic transducer which is excited by gear teeth incorporated on the low rotor shaft.
P2, Pamb, Pb, and P5 are sensed by pressure transducers (mounted in the FADEC) which produce a frequency proportional to the applied pressure.
These frequencies are determined and converted into digital words for use in



Power Supply Block Diagram
Figure 003

the control mode calculations. Engine Pressure Ratio (EPR) is computed digitally from P2 and P5. P2 and P5 transducers one mounted in channel A housing, PB and Pamb transducers in channel B housing.
The pressure signals from transducers are then crosswired to both channels.
Conversion of the above frequency inputs is accomplished by counters, which measure the length of time required (in terms of clock pulses of a known rate) for a given number of periods of the input frequency to pass.

6. Discrete Inputs
The FADEC receives eleven discretes from the engine and the airframe :
- alternate mode control select (both channels).
- P2/T2 probe heater status (both channels)
- fire handle position (both channels)
- channel reset request (both channels)
- RHC valve position (both channels)
- TCA valve position (channel A only).

7. Digital Interface

A. Transmitter
The FADEC incorporates a serial digital transmitter, which has two independent access ports. The transmitter conforms to the ARINC 429 specifications. The FADEC transmits the following data :
(1)Engine-rating paramater information
(2)Parameters used for engine control
(3)FADEC status and fault information
(4)FADEC system maintenance data
(5)Engine condition monitoring parameters.

B. Receiver
The FADEC incorporates one receiver per channel.
The receiver conforms to the ARINC 429 specifications.
The FADEC receives digital data from the Air Data Computers (ADC) and from the Thrust Control Computer (TCC).

8. Analog and Discrete Outputs
The redundant coil torque motors for fuel (WF), stator vane actuator (SVA), air/oil cooler actuator, intercompressor (2.5) bleed actuator and turbine case cooling actuator are driven by closed-loop current drivers in the FADEC. These drivers are responsive to commands from the seven magnitude bits plus one sign bit digital to analog converters.
Discrete outputs are controlled by electronic switches in the FADEC wich drive solenoid valves.

9. Interface with the Data Entry Modifier (DEM)
Channel A of the FADEC has an input for in-service data entry, which is cross-wired to Channel B. A single connector is used for this input and is capable of a minimum of 256 combinations of unique input.
The data entry modifier is an engine part and various models of the plug will go with various models of the engine. The data plug will define the engine model code and an EPR correction for each engine. Each modifier has

a separate part number, serial number, and data plate.
The FADEC performs comparisons between the local and cross-talked Data Entry Modifier inputs. If the interface is healthy and any bits disagree, a bit is set indicating disagreement and reversion to the N1 mode will result. The FADEC also checks for invalid states (Data Entry Modifier Code) if an invalid state is detected, the EEC will revert to the alternate mode.
In the event the plug becomes disconnected from the FADEC, the FADEC selects the all "0" state, which is also an invalid state resulting in reversion to the N1 mode. The FADEC reads in DEM code during initialization so that if the DEM plug were to become disconnected after initialization, the past value would be used and no reversion to N1 mode would result.

10. General FADEC Fault Accomodation Logic

The FADEC contains logic to identify and accommodate faults in a manner to insure continued safe operation of the engine. The following general information pertains to most input signals :

A. Range Tests

Input signals, once converted to digital form within the FADEC are compared with range limits which represent the valid output extremes of a sensor or the extremes of the sensed quantity. Electrical inputs to the FADEC are, in general, biased such that opens or shorts in external wiring will drive the digital signal out of range.

B. Rate Tests

Input signals, once converted to digital form within the FADEC are compared with the previous sample of this input. Changes which exceed known sensor or sensed quantity rate of change capabilities indicate faulty data. Rate tests are effective in detecting intermittent or noisy signals.

C. Fault Latching

Accomodation of faulty inputs sometimes requires control mode reconfiguration to alternate modes or use of similar but not identical input signals. Intermittent faults, if not properly handled, can cause cycling between modes or signals, resulting in unacceptable operation. The FADEC contains software techniques, called fault latching, which detect intermittent fault conditions and prevent mode cycling. The logic is designed to allow short-term faults to occur, then recover, but to latch out persistent faulty data and annunciate these persistent faults for maintenance action. The characteristics of this logic are :

(1) Sustained failures lasting longer than the specified fault latch time will cause fault annunciation and exclusion of this input signal.
(2) Short-term failures will cause mode changes, but complete recovery will occur when the fault "heals".
(3) Latches are cleared when control is depowered or manually reset.

11. Engine Warnings (Ref. Table 001) and (Ref. Fig. 004)
The following table shows the complete list of warnings with source of the detection, the warning threshold and the processing characteristics (warning sound, master light, inhibition phases).
NOTE : SC = Single Chime
CRC = Repetitive Chime
MW = MASTER WARNING
MC = MASTER CAUTION

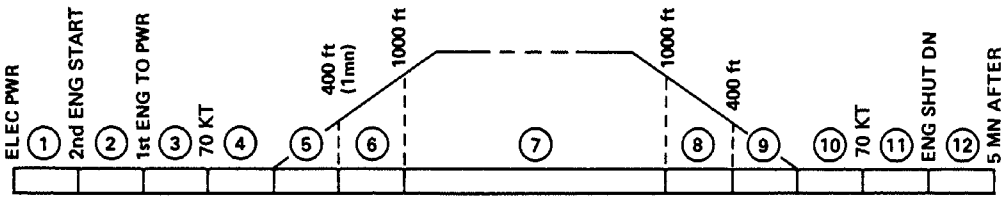
WARNING ENG1/ENG2	SOURCE	LABEL/BIT No./STATUS	WARN. THRESHOLD	WARN. SOUND	WARN. LIGHT	FLT.PHASES INHIBITION
OIL LO PRESS	PRESS. SWITCH		≤70 PSI	CRC	MW	4
OIL FILTER CLOG	PRESS. SWITCH		ΔP≥50PSI	SC	MC	4,5,9,10
OVERLIMIT N1	INDICATOR		≥111.4 %	SC	MC	4,9,10
OVERLIMIT N2	INDICATOR		≥104 %	SC	MC	4,9,10
OVERLIMIT EGT	INDICATOR		≥625°C	SC	MC	4,9,10
FUEL FILT. CLOG.	PRESS.SWITCH		ΔP≥5.5PSI	SC	MC	4,5,9,10
ENG SHUT DOWN	HP FUEL LEVER FIRE HANDLE			SC	MC	
OIL TEMP HI	SDAC - FADEC	273/22-1 or 273/21-1	≥163°C+ 20 min or ≥177°C	SC	MC	4,5,6,8,9
REV. UNLK	SWITCHES OR FADEC	270/19-1		SC	MC	1,2,4,5
EPR MODE FAULT	FADEC	270/18-1 and 270/26-0 NOT MANUAL		SC	MC	4,5,6
OVERSPEED DET	FADEC	270/15-1		SC	MC	
OIL TEMP LOW	FADEC	273/23-1	≤50°C	SC	MC	1,4 to 10, 12

WARNING ENG1/ENG2 ENG FAIL	SOURCE FADEC	LABEL/BIT No./STATUS 274/20-1 BOTH CHANNELS A and B	WARN. THRESHOLD	WARN. SOUND SC	WARN. LIGHT MC	FLT.PHASES INHIBITION NOT DURING SHUT DOWN OR START
THROTTLE FAULT LV (LAST VALUE)	FADEC	274/25-1 (in flight)		SC	MC	2,3,4,5
THROTTLE FAULT IDLE	FADEC	274/24-1 (on ground)		SC	MC	
FADEC CHANNEL A OR B FAULT	FADEC	350/16-1 A and B CHANNELS SEE NOTE 1		SC	MC	4 to 10
FADEC MINOR FAULT	FADEC	350/17-1 A or B CHANNEL		SC	MC	2 to 10
FADEC OVHT	FADEC	273/25-1 A or B CHANNEL	105°C	SC	MC	1,4,5,6,12
ENGINE BELOW IDLE	FADEC	270/15-1 and 272/14-0 or 351/14-1 A and B CHANNEL or 351/24-1 A and B CHANNEL		SC	MC	
ENGINE AT IDLE	FADEC	274/24-1 THROTTLE. FAULT ON GROUND or 270/19-1 REV UNLK		SC	MC	
ENGINE N1	FADEC	270/26-1				1,4,5,10,12

WARNING ENG1/ENG2 MODE	SOURCE	LABEL/BIT No./STATUS MANUAL and 270/18-1	WARN. THRESHOLD	WARN. SOUND	WARN. LIGHT	FLT.PHASES INHIBITION

Table 001

NOTE 1 : Both channels displayed even when fault is in one channel only.



BM5 73 21 00 0 KGMO - 01

Flight Phase Inhibition
Figure 004

FULL AUTHORITY DIGITAL ENGINE CONTROL UNIT - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform
B.	Circuit Breaker Safety Clips
C.	Packings
D. Material No.P03-001	Oils (Ref. 70-00-00)
E. Material No.P05-289	Special Materials (Ref. 70-00-00)
F. Material No.P05-291	Special Materials (Ref. 70-00-00)
G. Material No.P05-292	Special Materials (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Engine Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENGINES/ENG1 FADEC SOLENOIDS CHANNEL A	19KS	332/U70
133VU	ENGINES/ENG1 FADEC SOLENOIDS CHANNEL B	21KS	331/V70
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
For engine 2			
133VU	ENGINES/ENG2 FADEC SOLENOIDS CHANNEL A	18KS	332/U71
133VU	ENGINES/ENG2 FADEC SOLENOIDS CHANNEL B	20KS	331/V69
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(2)Install access platform.

(3)Open the fan cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401, 402)

CAUTION : FADEC IS SUSCEPTIBLE TO DAMAGE BY CUMULATIVE EXPOSURE TO X-RAYS. FADEC MUST BE REMOVED FROM ENGINE PRIOR TO ENGINE BEING EXPOSED TO X-RAYS, AND PRECAUTION SHOULD BE TAKEN FOR THE FADEC ON THE OTHER SIDE ENGINE.

(1)Disconnect FADEC programming plug from electronic engine control upper left connector and leave plug attached to engine by its lanyard.

(2)Disconnect D5001P, W1P6, W1P7 and W1P8 harness connectors from rear side of control (Channel A).

(3)Disconnect D5000P, W2P2, W2P3 and W2P4 harness connectors from front side of control (Channel B).

(4)Disconnect four flex hoses from bottom of control.
(5)Remove bolt from upper front corner of control and disconnect ground strap.
(6)Remove bolts and washers from mounts at four corners and remove control from engine.
(7)Remove four adapters from control (where flex hoses were attached). Discard packings.
(8)Install protective closures.

C. Installation (Ref. Fig. 401, 402)

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, OR PACKINGS. CONTAMINATION OF FADEC CAN OCCUR.

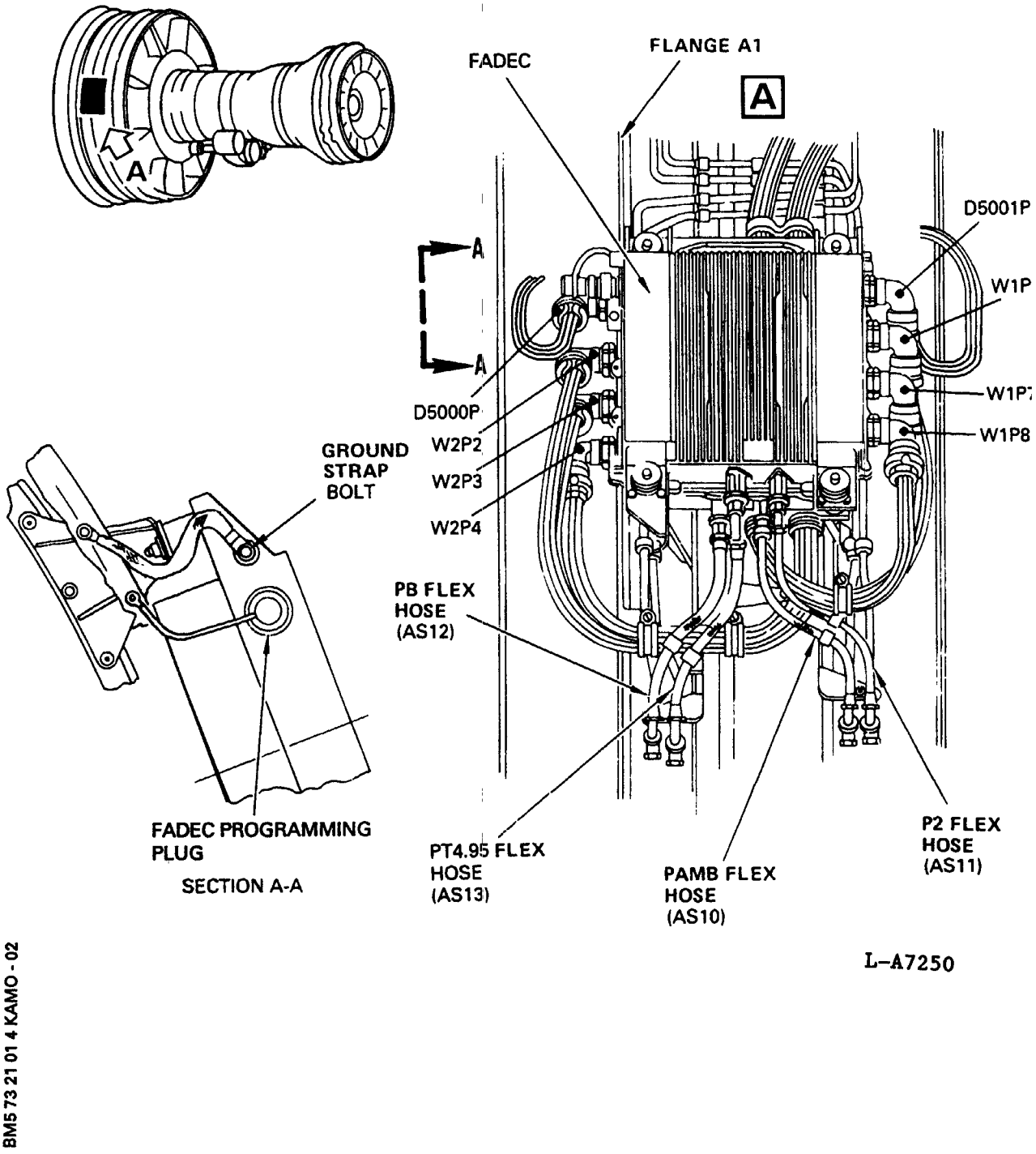
CAUTION : EXAMINE THE ENGINE FAN CASE AT APPROXIMATELY THE ONE O'CLOCK POSITION FOR A FADEC CAUTION LABEL. THIS LABEL SHOWS THAT A UNIQUE MOUNTING EEC IS NECESSARY BECAUSE A HPC FRONT ASYMETRIC CASE, (POST SB PW4ENG 72-743), IS INSTALLED IN THE ENGINE. MAKE SURE THE CORRECT EEC IS INSTALLED.

CAUTION : IF THE ENGINE HAS A W1 AND W2 "WITH YELLOW BANDS" AND A LABEL ON FAN CASE SHOWING AN ENGINE IN RING CASE CONFIGURATION, YOU MUST INSTALL AN EEC WITH THE YELLOW AND BLACK LABEL FOR RING CASE CONFIGURATION. IF YOU DO NOT INSTALL THE CORRECT HARDWARE, THE ENGINE WILL NOT OPERATE.

CAUTION : FOR ENGINES WITHOUT RING CASE CONFIGURATION (PRE SB PW4ENG 72-756 AND PRE SB PW4ENG 72-759), IT IS PERMITTED TO USE AN EEC WITH THE YELLOW AND BLACK LABEL, EXCEPT FOR ENGINES WITH HPC FRONT ASYMETRIC CASE (POST SB PW4ENG 72-743).

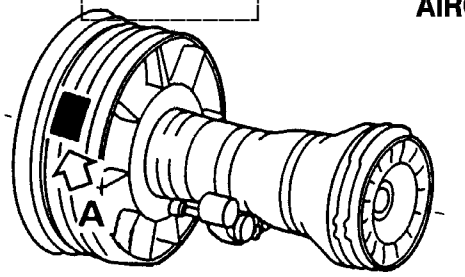
(1)Make certain the EEC to be installed is permitted for the engine configuration (Ref. Fig. 403, 404).
(2)Remove protective closures.
(3)If new FADEC unit is to be installed comply with the following :
(a)Install packing to adapter and install adapter to port marked P2. TORQUE adapter to between 65 and 75 lbf.in. (0.73 and 0.85 m.daN).
(b)Install packing to adapter and install adapter to port marked PAMB. TORQUE adapter to between 90 and 100 lbf.in. (1.02 and 1.13 m.daN).
(c)Install packing to adapter and install adapter to port marked PB. TORQUE adapter to between 110 and 120 lbf.in. (1.24 and 1.36 m.daN).
(d)Install packing to adapter and install adapter to port marked P5. TORQUE adapter to between 150 and 170 lbf.in. (1.69. and 1.92 m.daN).
(4)Position electronic engine control FADEC unit to mounting brackets on fan case, at approximately the 10 o'clock position, with the four pressure sensing ports downward.
(5)Secure FADEC unit with bolts, threads lubricated with Material No.P03-001 TORQUE bolts to between 150 and 170 lbf.in. (1.69 and 1.92 m.daN).

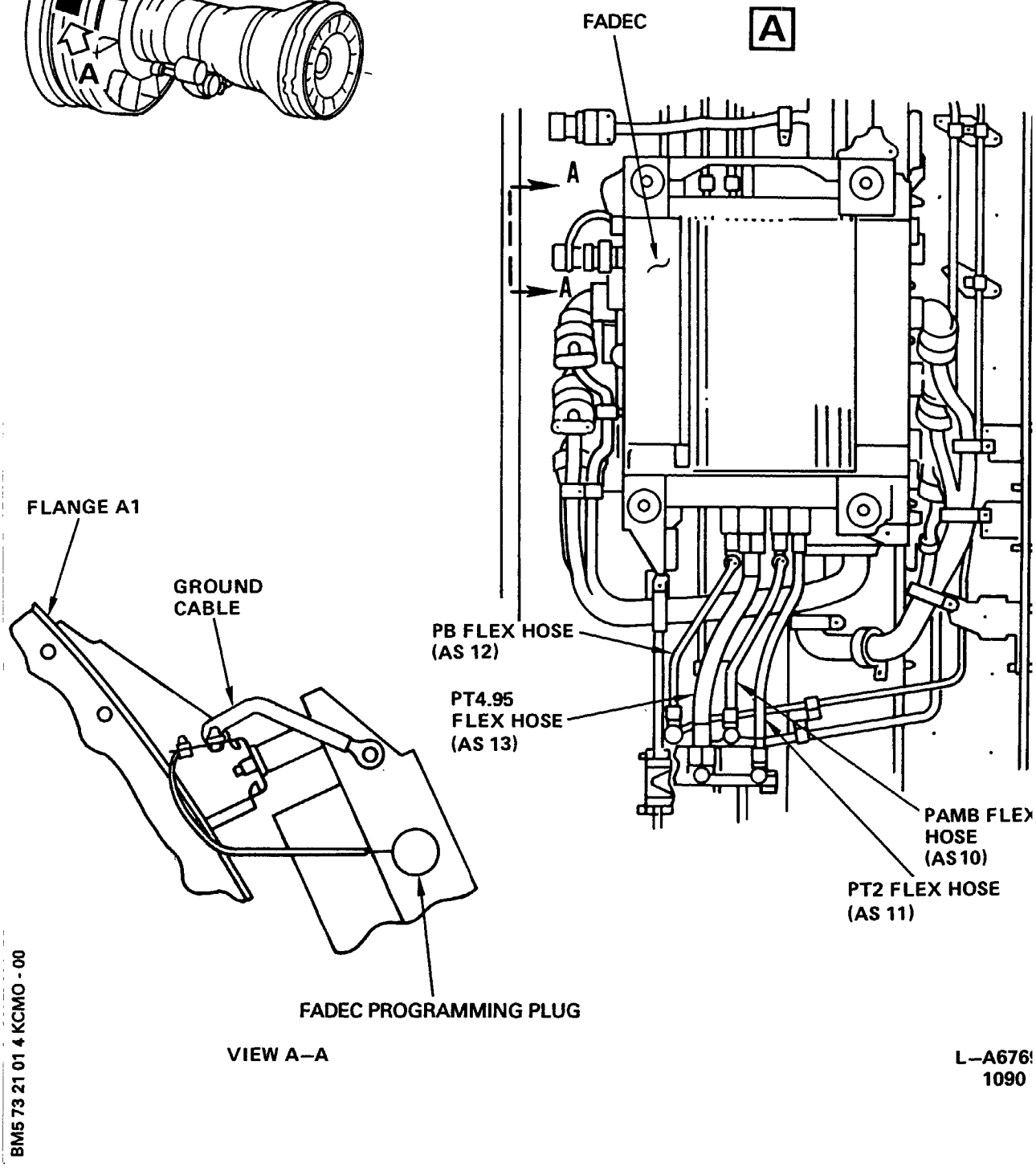
CAUTION : WHEN YOU TORQUE THE FOLLOWING HOSE NUTS (AS12), (AS13), (AS10) AND (AS11), YOU MUST HOLD THE WRENCH FLATS OF THE ADAPTERS IN THE ELECTRONIC ENGINE CONTROL FADEC.
THIS WILL PREVENT DAMAGE TO THE THREADS IN THE FADEC.



BM5732101 4 KAMO - 02

Full Authority Digital Engine Control (FADEC) Unit
(Basic Configuration)
Figure 401



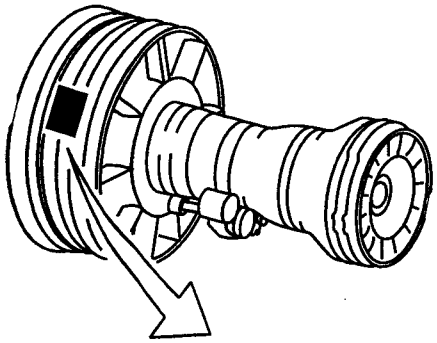


Full Authority Digital Engine Control (FADEC) Unit
(New Configuration)
Figure 402

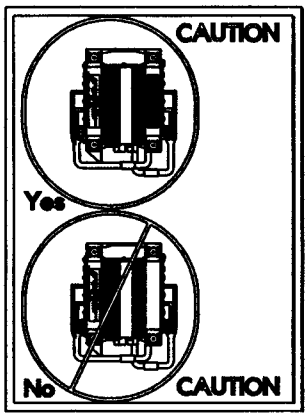
(6)Attach front flex hose (AS 12) to adapter in port marked PB. TORQUE flex hose nut to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN).
(a)(Post SB PW4ENG 72-645) Install the Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the hose nuts.
(7)Attach next flex hose (AS 13) (moving rearward on fan case) to adapter in port marked P5. TORQUE flex hose nut to between 450 and 500 lbf.in. (5.08 and 5.65 m.daN).
(a)If the hose nuts have lockwire holes, install the Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the hose nuts.
(8)Attach third flex hose (AS 10) rearward to adapter in port marked PAMB. TORQUE flex hose nut to between 135 and 150 lbf.in. (1.52 and 1.69 m.daN).
(a)If the hose nuts have lockwire holes, install the Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the hose nuts.
(9)Attach last flex hose (AS 11) to adapter in port marked P2. TORQUE flex hose nut to between 90 and 100 lbf.in. (1.02 and 1.13 m.daN).
(a)If the hose nuts have lockwire holes, install the Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the hose nuts.
CAUTION : PRIOR TO CONNECTING GROUND CABLE TO FADEC UNIT, CHECK TO ENSURE THAT CABLE MOUNTING LUGS ARE SECURE AND THAT CABLE STRANDS ARE AT LEAST 75 PERCENT UNBROKEN. LOOSE LUGS OR EXCESSIVE BREAKAGE IN CABLE STRANDS MAY RESULT IN INADEQUATE LIGHTNING STRIKE PROTECTION.
(10)Position ground strap to threaded hole in upper front corner of control and secure with bolt threads lubricated with Material No.P03-001. TORQUE bolt to between 75 and 85 lbf.in. (0.85 and 0.96 m.daN).
(11)Connect D5001P, W1P6, W1P7, and W1P8 harness connectors to their respective connectors on rear (Channel A) of control.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(12)Connect D5000P, W2P2, WP3, and W2P4 harness connectors to their respective connectors on front (Channel B) of control.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(13)Install FADEC programming plug (attached to engine by lanyard) to connector on upper left side of control.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE PROGRAMMING PLUG INSTALLATION (REF. 70-00-00, P. BLOCK 201, SAME AS THE HARNESS CONNECTOR INSTALLATION PROCEDURE). IF YOU

USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE PLUG CAN OCCUR. A LOOSE PLUG CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

D. Close-Up and Test
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close fan cowl doors (Ref. 71-13-00, P. Block 301).
(3)Remove access platform.
(4)Remove safety clips and tags and close circuit breakers : 19KS, 21KS, 35KS, 37KS, 18KS, 20KS, 34KS, 36KS.
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

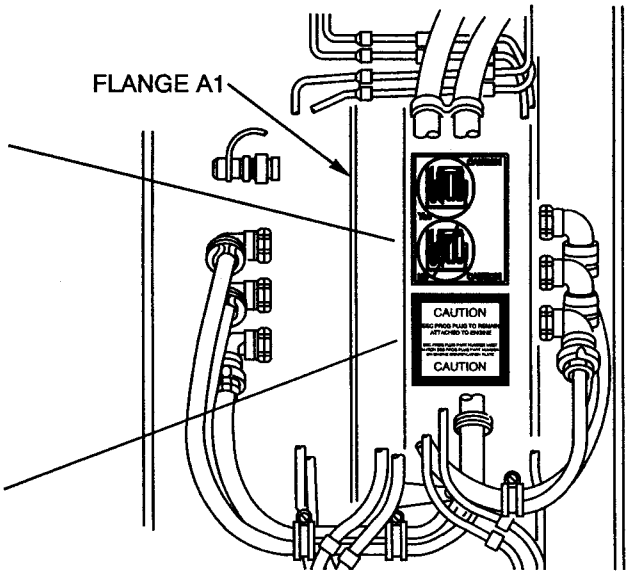


EEC AND HARNESS CAUTION INSTALLATION LABEL (USED WITH RING CASE CONFIGURATION) SEE NOTE 1



EEC FAN CASE INSTALLATION LABEL (USED WITH ALL CONFIGURATIONS)


CAUTION
EEC PROG PLUG TO REMAIN ATTACHED TO ENGINE
EEC PROG PLUG PART NUMBER MUST MATCH EEC PROG PLUG PART NUMBER ON ENGINE IDENTIFICATION PLATE
CAUTION



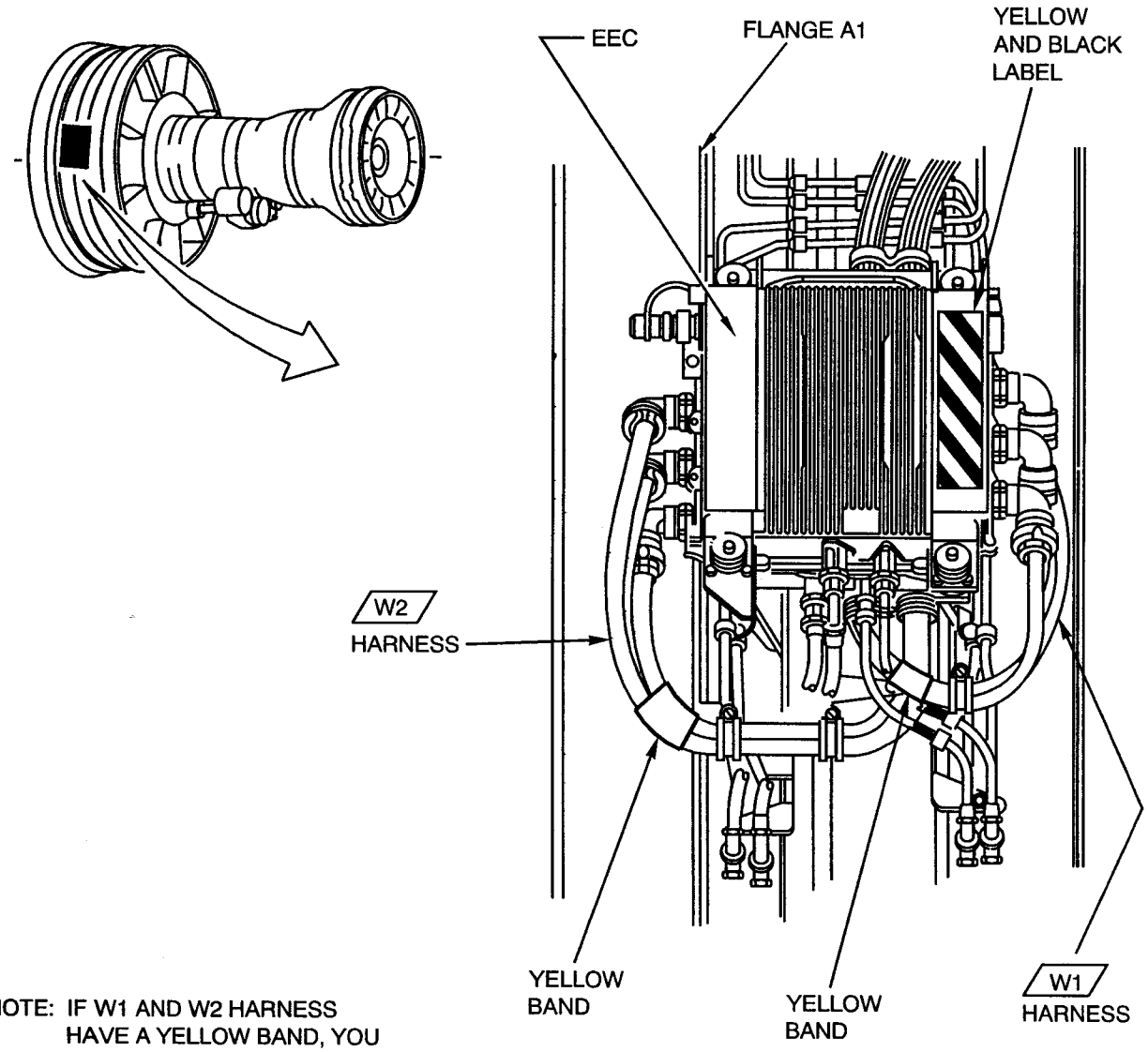
FAN CASE WITH EEC REMOVED
ENGINE WITH RING CASE CONFIGURATION: SEE NOTE 1

BM5 73 21 01 4 KEMA 00

NOTE 1: ENGINES THAT HAVE NOT INCORPORATED RING CASE HPC WILL NOT HAVE ANY LABEL INSTALLED AT THIS LOCATION.

L-D0826 (0603)
PW V

Electronic Engine Control Fan Case
EEC Installation Labels (Sheet 1/2)
Figure 403



NOTE: IF W1 AND W2 HARNESS HAVE A YELLOW BAND, YOU MUST HAVE THE EEC WITH THE YELLOW AND BLACK LABEL FOR RING CASE CONFIGURATION.
(POST SB PW4ENG 72-756) OR
(POST SB PW4ENG 72-759)

L-D0827 (0603)
PW V

BM5 73 21 01 4 KEMM 00

Electronic Engine Control Fan Case
EEC Installation Labels (Sheet 2/2)
Figure 403

ENGINE CONFIGURATION	SB	FADEC SOFTWARE	W1 AND W2 HARNESS
SYMETRIC CASE	BASIC	ALL PERMITTED	WITHOUT YELLOW BAND
ASYMETRIC CASE	POST SB 72-743	SCN12B/AF	WITHOUT YELLOW BAND
SYMETRIC CASE AND RING CASE	POST SB 72-756	SCN13/AH	WITH YELLOW BAND
ASYMETRIC CASE AND RING CASE	POST SB 72-759	SCN13/AH	WITH YELLOW BAND

NOTE: W1 AND W2 HARNESS WITH YELLOW BAND ARE HARNESS MODIFIED INCLUDING JUMPERS ON WIRING.

BM5 73 21 01 4 KGM0 00

L-D0980 (0603)
PW V

Electronic Engine Control Fan Case
EEC Installation Labels
Figure 404

FULL AUTHORITY DIGITAL ELECTRONIC ENGINE CONTROL UNIT - INSPECTION/CHECK

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Torque Wrench
C.	Dry Low Pressure Air Supplier
D.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
E. Material No.P05-289	Special Materials (Ref. 70-00-00)
F. Material No.P05-291	Special Materials (Ref. 70-00-00)
G. Material No.P05-292	Special Materials (Ref. 70-00-00)
H. Material No.P11-014	Special Materials (Ref. 70-00-00)
Referenced Procedure	
- 71-13-00, P. Block 301	Cowl Doors

2. Procedure (Ref. Fig. 601)

A. Job Set-Up
(1)Open, safety and tag the appropriate circuit breakers and open the fan cowl doors (Ref. 71-13-00, P. Block 301).

B. Inspect PB Water Trap
(1)Remove lockwire or safety cable and remove water trap from FADEC PB manifold.
(2)Remove any water from the water trap.
(3)Clean the water trap vent hole as follows :
(a)Clean the vent hole in the condensation trap with a 0.010 - 0.015 in. (0.254 - 0.381 mm) diameter steel wire.
(b)Clean the side walls of the trap with a rough cylindrical bristle brush (with strong fibers such as natural, nylon, polyester or tampico) that will not scratch the trap interior.
NOTE : Do not use ferrous material type brushes. Use a stainless steel brush only.
(c)Clean the bottom of the trap with a stainless steel brush (such as a dremmel #532) and Materia No.P11-014 or equivalent. After you clean the bottom of the trap, check the inside of the trap and the bleed hole to make sure it is free of loose material, fluid, soot or scale deposites. A 0.010 - 0.015 in. (0.254 - 0.381 mm) diameter steel wire or drill bit must be able to easily pass through the bleed hole without collecting or dislodging debris. Do this procedure again, as necessary.
(d)Rinse the trap with water and blow compressed air through the trap to clean the condensation trap of any unwanted material.
(e)Do a visual inspection of the trap to make sure there are no obstructions or blockages. A 10X magnifying glass with a light can be used to help in the inspection. If you can see through the hole, the trap can be re-installed.
(f)If cleaning does not remove the unwanted material or blockage, replace the condensation trap.

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, AND PACKINGS OR CONTAMINATION OF FADEC COULD RESULT.

(4)For basic configuration (Ref. Fig. 601) : install water trap to tee on manifold. TORQUE water trap nut to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nut.

(5)For new configuration (Ref. Fig. 602) : install water trap to tee on manifold. TORQUE water trap nut to between 320 and 350 lbf.in. (3.62 and 3.95 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the nut.

C. Inspect PT4.95 Water Trap

(1)Remove lockwire or safety cable and cap.

(2)Remove any water from the water trap.

R (3)Clean the water trap as follows :

R (a)Clean the side walls of the trap with a rough cylindrical bristle brush (with strong fibers such as natural, nylon, polyester or tampico) that will not scratch the trap interior.

NOTE : Do not use ferrous material type brushes. Use a stainless steel brush only.

R (b)Clean the bottom of the trap with a stainless steel brush (such as a dremmel #532) and Materia No.P11-014 or equivalent. After you clean
R the bottom of the trap, check the inside of the trap to make sure
R it is free of loose material, fluid, soot or scale deposites.
R Do this procedure again, as necessary.

R (c)Rinse the trap with water and blow compressed air through the trap to clean the condensation trap of any unwanted material.

R (d)Do a visual inspection of the trap to make sure there are no obstructions or blockages. A 10X magnifying glass with a light can be
R used to help in the inspection.

R (e)If cleaning does not remove the unwanted material or blockage, replace the condensation trap.

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, AND PACKINGS OR CONTAMINATION OF FADEC COULD RESULT.

(4)Install cap to tee. TORQUE cap to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the cap.

D. Inspect PAMB Water Trap

(1)Remove lockwire or safety cable and cap.

(2)Remove any water from the water trap.

R (3)Clean the water trap as follows :

R (a)Clean the side walls of the trap with a rough cylindrical bristle brush (with strong fibers such as natural, nylon, polyester or tampico) that will not scratch the trap interior.

NOTE : Do not use ferrous material type brushes. Use a stainless steel brush only.

R (b)Clean the bottom of the trap with a stainless steel brush (such as a

dremmel #532) and Materia No.P11-014 or equivalent. After you clean
R the bottom of the trap, check the inside of the trap to make sure
R it is free of loose material, fluid, soot or scale deposites.
R Do this procedure again, as necessary.
R (c)Rinse the trap with water and blow compressed air through the trap to clean the condensation trap of any unwanted material.
R (d)Do a visual inspection of the trap to make sure there are no obstructions or blockages. A 10X magnifying glass with a light can be
R used to help in the inspection.
R (e)If cleaning does not remove the unwanted material or blockage, replace the condensation trap.

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, AND PACKINGS OR CONTAMINATION OF FADEC COULD RESULT.

(4)Install cap to tee. TORQUE cap to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the cap.

E. Inspect PT2 Water Trap

(1)Remove lockwire or safety cable and cap.
(2)Remove any water from the water trap.
R (3)Clean the water trap as follows :
R (a)Clean the side walls of the trap with a rough cylindrical bristle brush (with strong fibers such as natural, nylon, polyester or tampico) that will not scratch the trap interior.

NOTE : Do not use ferrous material type brushes. Use a stainless steel brush only.

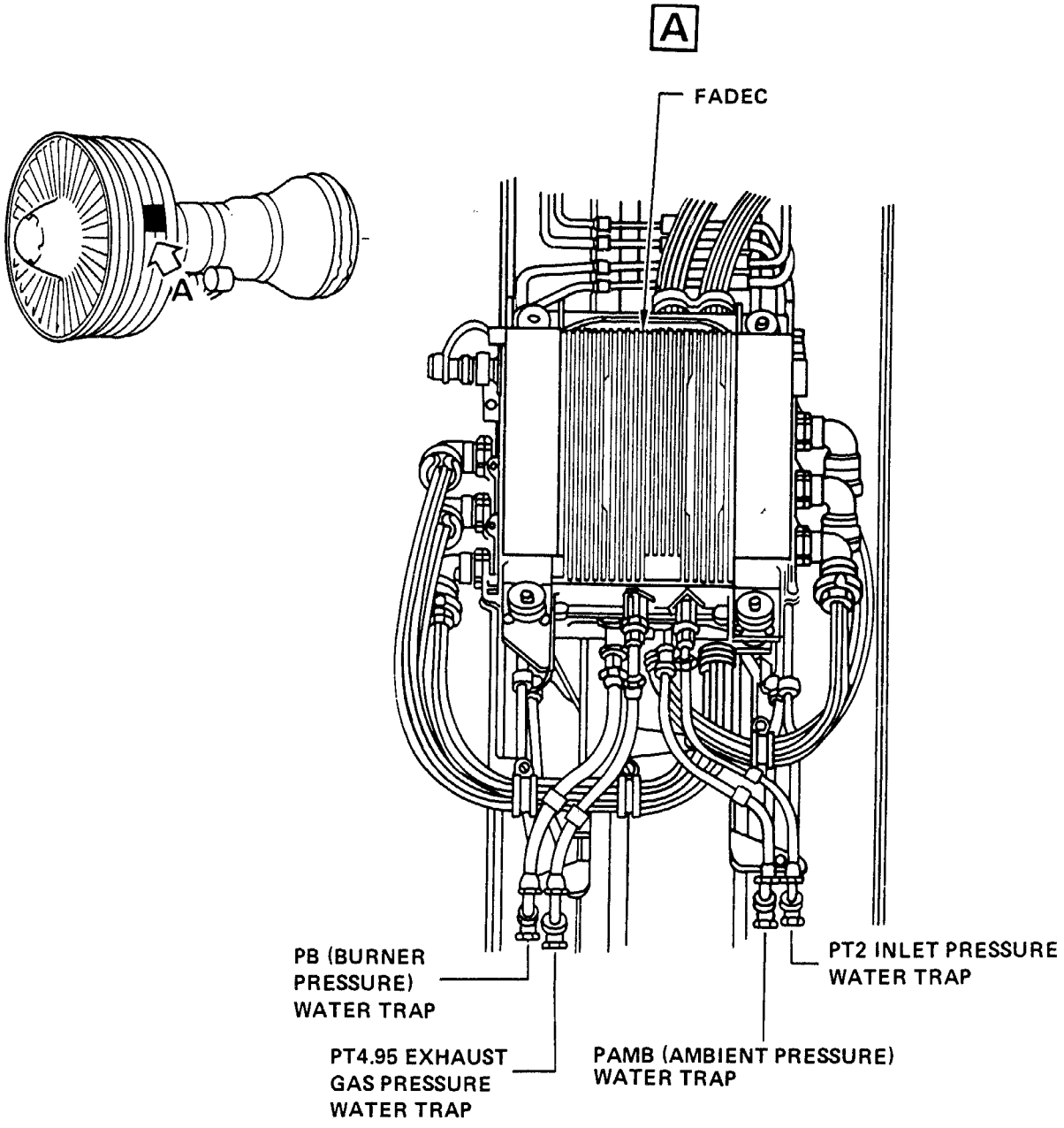
R (b)Clean the bottom of the trap with a stainless steel brush (such as a dremmel #532) and Materia No.P11-014 or equivalent. After you clean
R the bottom of the trap, check the inside of the trap to make sure
R it is free of loose material, fluid, soot or scale deposites.
R Do this procedure again, as necessary.
R (c)Rinse the trap with water and blow compressed air through the trap to clean the condensation trap of any unwanted material.
R (d)Do a visual inspection of the trap to make sure there are no obstructions or blockages. A 10X magnifying glass with a light can be
R used to help in the inspection.
R (e)If cleaning does not remove the unwanted material or blockage, replace the condensation trap.

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, AND PACKINGS OR CONTAMINATION OF FADEC COULD RESULT.

(4)Install cap to tee. TORQUE cap to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the cap.

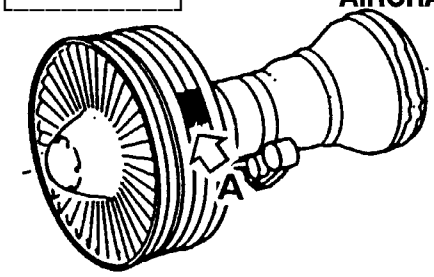
F. Close-Up

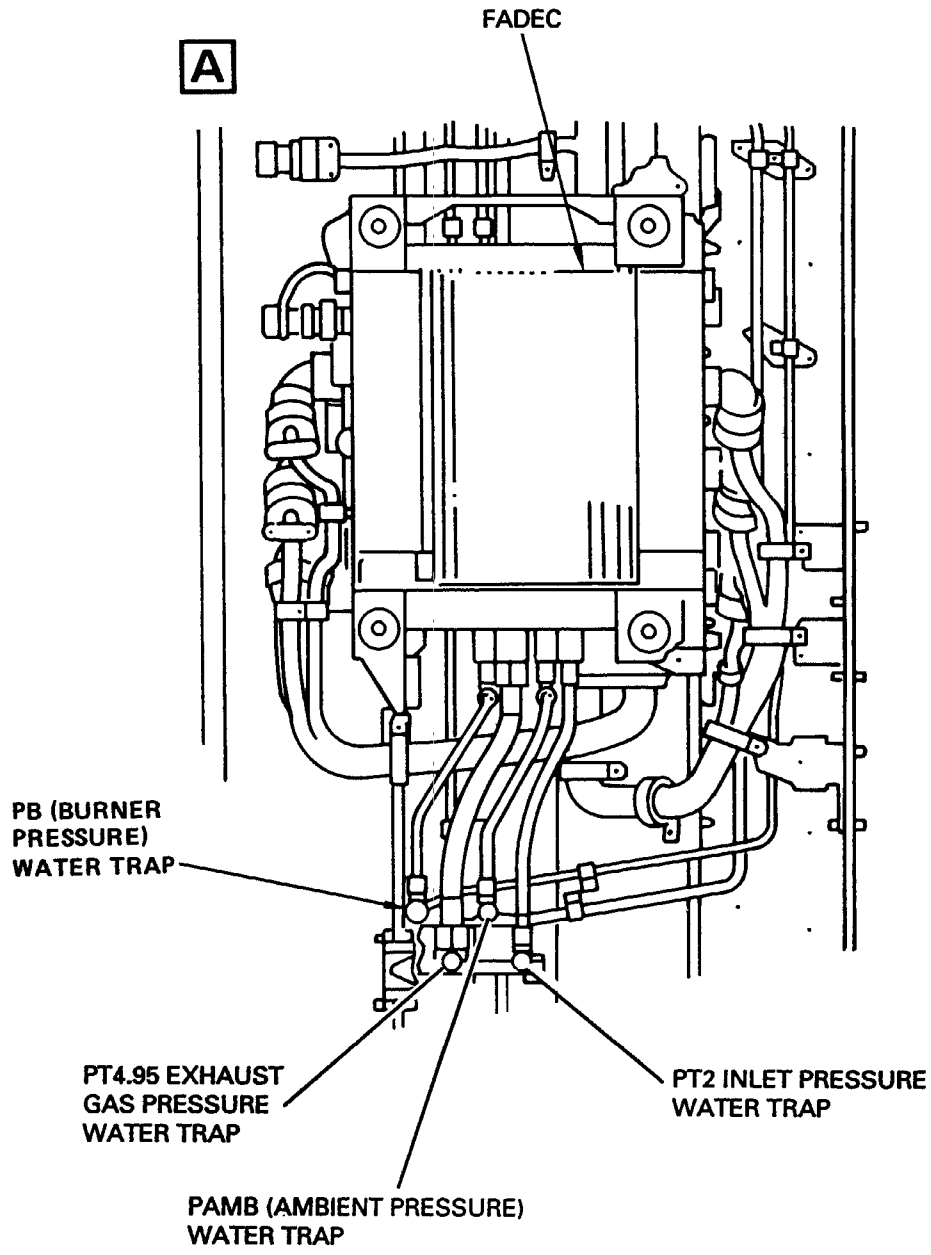
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close fan cowl doors (Ref. 71-13-00, P. Block 301).
Remove safety clips and tags and close circuit breakers.



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FADEC - Water Traps Inspection (Basic Configuration)
Figure 601





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FADEC - Water Traps Inspection (New Configuration)
Figure 602

SUPPLEMENTARY CONTROL UNIT - DESCRIPTION AND OPERATION

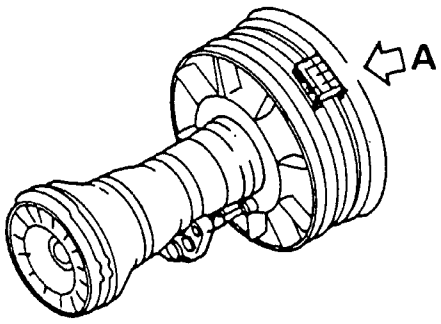
1. Description (Ref. Fig. 001, 002)

The Supplemental Control Unit (SCU) supplies the Electronic Engine Control (EEC) conditioned aircraft power source, and Engine Data Multiplexer (EDM). The SCU receives Stage 2.5 temperature, Stage 2.5 pressure and the engine serial number by using special engine sensors.

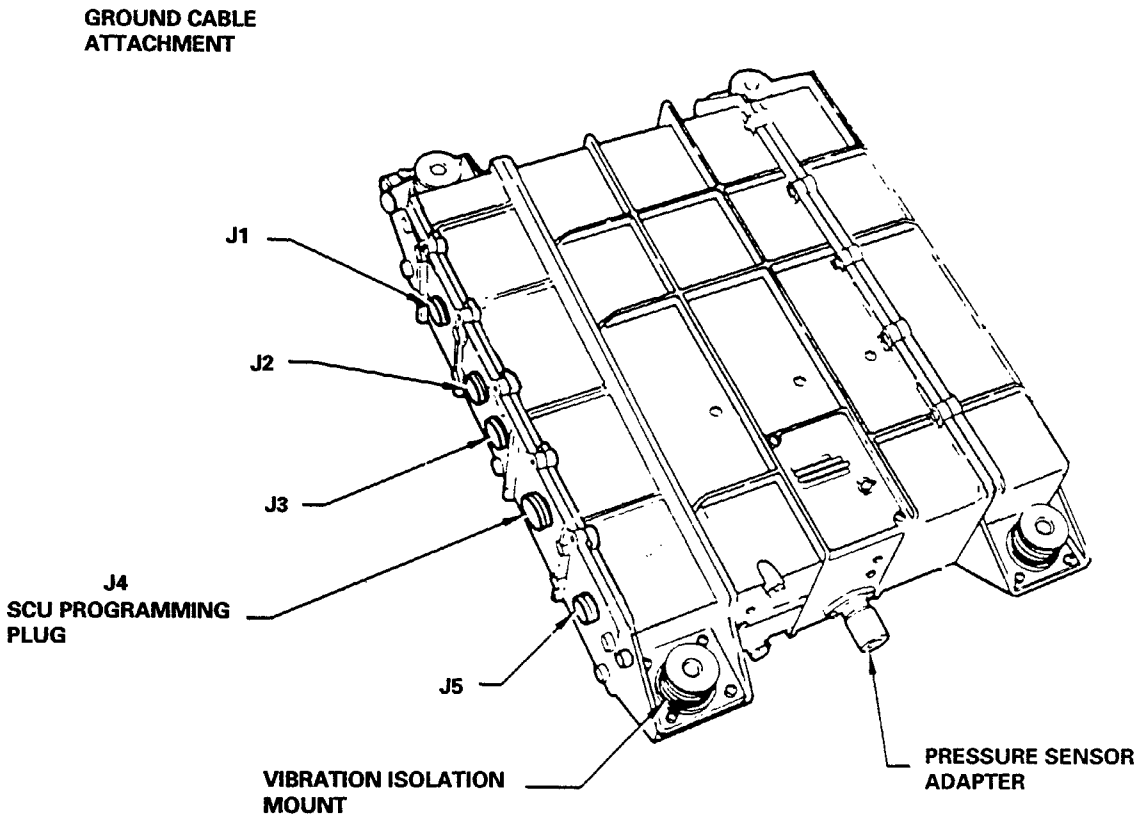
The SCU also supplies Aeronautical Radio Incorporated (ARINC) output for use, engine condition monitoring, and to make control system self-test information available to maintenance persons.

Aircraft Power Conditioning - The power conditioning function of the SCU uses 28 VDC power from the airframe to supply a second source of EEC power if the Permanent Magnet Alternator (PMA) were to malfunction.

Engine Data Multiplexer - The EDM function receives input of temperature and pressure from the engine station 2.5, receives EEC ARINC serial digital output signal, and helps send (process) input of the engine serial number. This added data is output to the airframe for use in engine condition monitoring.



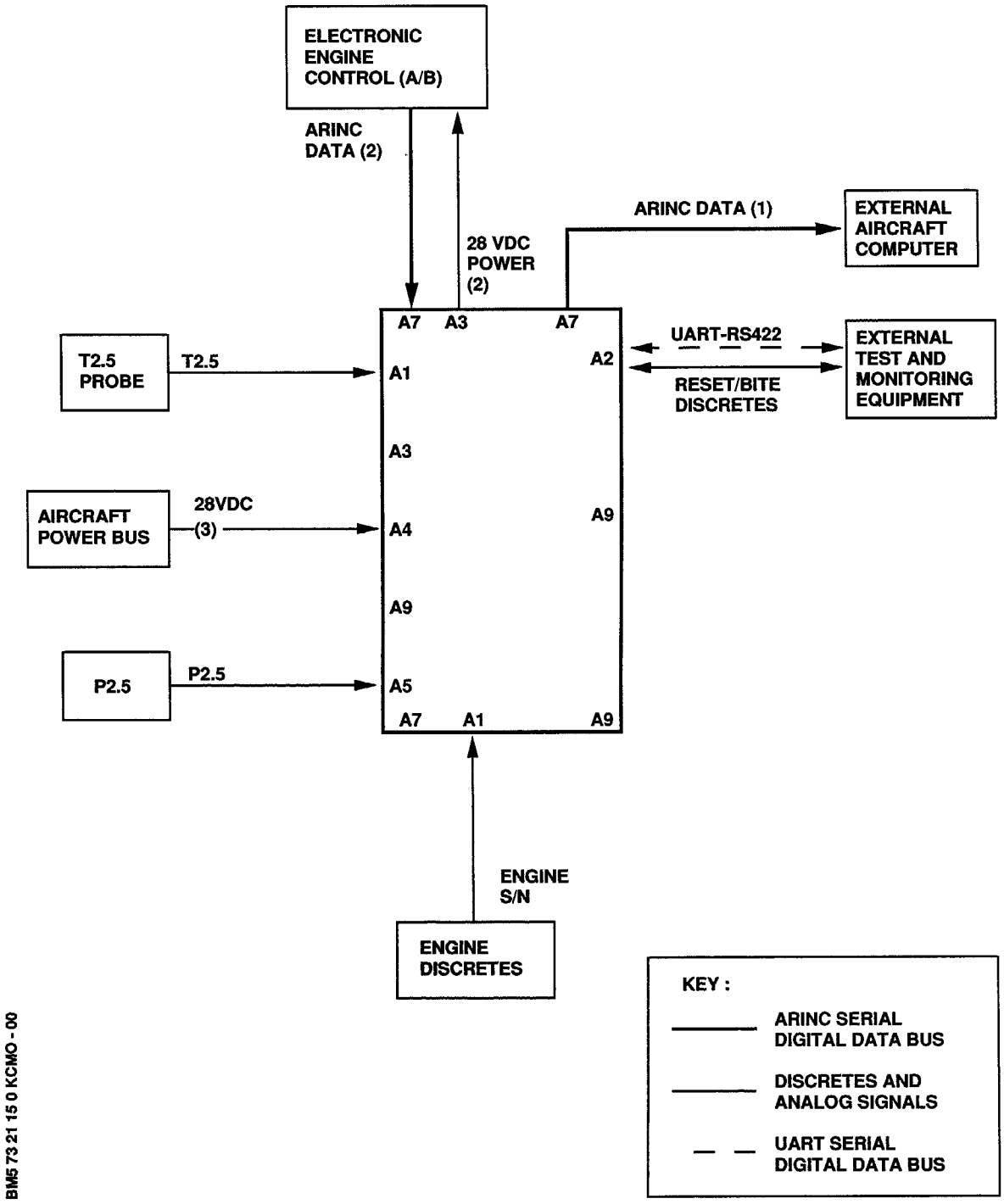
A



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Supplemental Control Unit
Figure 001



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SCU External Interfaces
Figure 002

SUPPLEMENTAL CONTROL UNIT (SCU) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform
B.	Packing, AS3208-04
C.	Lockwire, AS3214-02
D. Material No.P03-001	Oils (Ref. 70-00-00)
E. Material No.P06-035	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Engines - Maintenance Pratices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
For engine 2			
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85

(2)Open right fan cowl door (Ref. 71-13-00, P. Block 301).

(3)Install access platform.

B. Removal (Ref. Fig. 401)

(1)Disconnect the connector assembly (SCU programming plug) (7) from the lower rear side connector on the supplemental control unit. Keep the connector assembly attached to the engine by its lanyard.

(2)Disconnect the W11P34 connector (1) and the W11P33 connector (2) from the rear side of the supplemental control unit.

(3)Remove the bolt (9) from the top rear side of the supplemental control unit and disconnect the ground cable.

(4)If the supplemental control unit has the multiplexing option, remove the top connector of the hose assembly (3) from the bottom side of the supplemental control unit.

(5)Remove the bolts and washers (8) from the mounts at the four corners and remove the supplemental control unit from the engine.

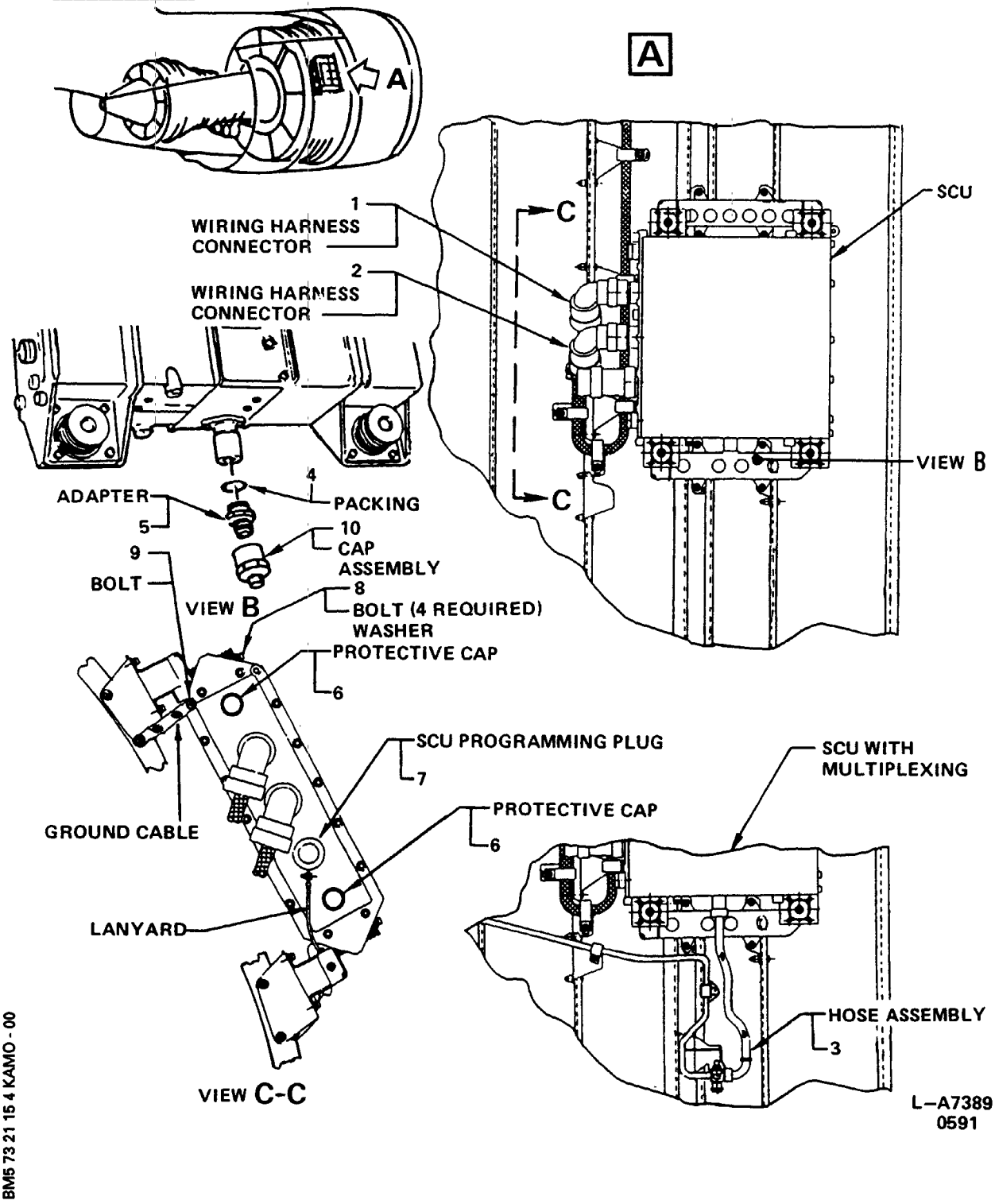
(6)If the supplemental control unit does not have the multiplexing option and the unit is to be replaced, remove the cap assembly (10) from the bottom side of the supplemental control unit.

(7)If the supplemental control unit is to be replaced, remove the adapter (5) from the bottom side of the supplemental control unit. Discard the

packing (4).

(8) If the supplemental control unit does not have the auto-start option and the unit is to be replaced, remove the two protective caps (6) from the rear side of the supplemental control unit.

(9) Install protection covers to the openings and electrical connectors on the supplemental control unit and the wiring harness.



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Supplemental Control Unit
Figure 401

C. Installation (Ref. Fig. 401)

(1)Remove the protection covers from the openings and the electrical connectors on the supplemental control unit and the wiring harness.

CAUTION : DO NOT USE LUBRICANTS ON THE SENSING HOSE, ADAPTER OR PACKING UNLESS SPECIFIED DIFFERENTLY. LUBRICANTS CAN CAUSE CONTAMINATION OF THE SCU.

(2)If a new supplemental control unit is to be installed, do the following.

(a)Install a packing (4), lubricated with Material No.P06-035, onto an adapter (5). Install the adapter into the opening at the data plate end of the supplemental control unit. TORQUE the adapter to between 65 and 75 lbf.in. (0.74 and 0.84 m.daN).

(b)If the supplemental control unit does not have the multiplexing option, install the cap assembly (10) to the adapter (5) at the data plate end of the supplemental control unit. TORQUE the cap assembly to between 270 and 300 lbf.in. (3.06 and 3.38 m.daN). Wirelock cap assembly.

(3)If a new supplemental control unit does not have the auto-start option and the unit is to be replaced, install two protective caps (6) to the electrical connectors identified as J1 and J5. Carefully push the protective caps into the receptacle and tighten the cap assemblies by hand. Wirelock protective caps.

(4)Put the supplemental control unit to the mount brackets on the fan case at approximately the 2:30 o'clock position with the electrical connectors pointing rearward. Attach the supplemental control unit to the brackets with four bolts and washers (8), threads lubricated with Material No.P03-001. TORQUE the bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

CAUTION : BEFORE YOU CONNECT THE GROUND CABLE TO THE SCU, EXAMINE THE CABLE MOUNTING LUGS TO MAKE SURE THE LUGS ARE SECURED TO THE CABLE AND THE CABLE WIRE (STRANDS) ARE AT LEAST 75 PERCENT NOT BROKEN. LOOSE LUGS OR TOO MANY BROKEN WIRES (STRANDS) CANNOT GIVE SUFFICIENT PROTECTION FROM A LIGHTNING STRIKE.

(5)Put the ground cable to the threaded hole in the top rear side of the supplemental control unit. Attach the cable to the supplemental control unit with a bolt (9), threads lubricated with Material No.P03-001. If the ground cable was removed from Flange B1, put the opposite end of the ground cable to the bolt hole on Flange B1. Attach the cable to the Flange with a bolt, threads lubricated with Material No.P03-001, washer and nut. TORQUE the two bolts to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

CAUTION : DO NOT USE LUBRICANTS ON THE SENSING HOSE OR GASKET UNLESS SPECIFIED DIFFERENTLY. LUBRICANT CAN CAUSE CONTAMINATION OF THE SCU.

(6)If the supplemental control unit has the multiplexing option, install the top hose connector of the hose assembly (3) to the adapter (5) at the bottom side of the supplemental control unit. TORQUE the hose connector to between 270 and 300 lbf.in. (3.06 and 3.38 m.daN).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATIS-

FACTORY LIGHTNING PROTECTION.

(7)Connect W11P34 harness connector (1) to the receptacle identified as J2 and connect W11P33 harness connector (2) to the receptacle identified as J3 on the supplemental control unit.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(8)Install the SCU programming plug (7) that is attached to the engine with a lanyard to the receptacle identified as J4 on the supplemental control unit (Ref. 70-00-00, P. Block 201) (same as electrical harness connector installation procedure).

Align the connector keyway to engage the mating receptacle. Carefully push the connector into the receptacle and tighten the connector coupling ring by hand. The connector is correctly tightened when the color band closest to the threads of the receptacle does not show.

D. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close right fan cowl door (Ref. 71-13-00, P. Block 301).

(3)Remove access platform.

(4)Remove safety clips and tags and close circuit breakers 34KS, 35KS, 36KS, 37KS.

(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

SCU PROGRAMMING PLUG - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform
B.	Collar (ST2185-06)
C.	Pin-Rivet (ST1106-02)
Referenced Procedures	
- 70-00-00, P. Block 201	Engines - Maintenance Pratices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Door

2. Procedure

A. Job Set-up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
For engine 2			
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85

(2)Install access platform.

(3)Open right fan cowl door (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

NOTE : Inside the programming plug, the engine serial number is identified (by electronics) to a specified engine (by serial number). Programming plugs are not interchangeable with each other unless a new plug is made to the same engine serial number.

(1)Remove the collar and pin that attach the lanyard to the SCU lower (rearward) mount bracket.

(2)Loosen and remove the programming plug from the SCU.

(3)Install protection covers to the SCU connector and to the programming plug.

C. Installation (Ref. Fig. 401)

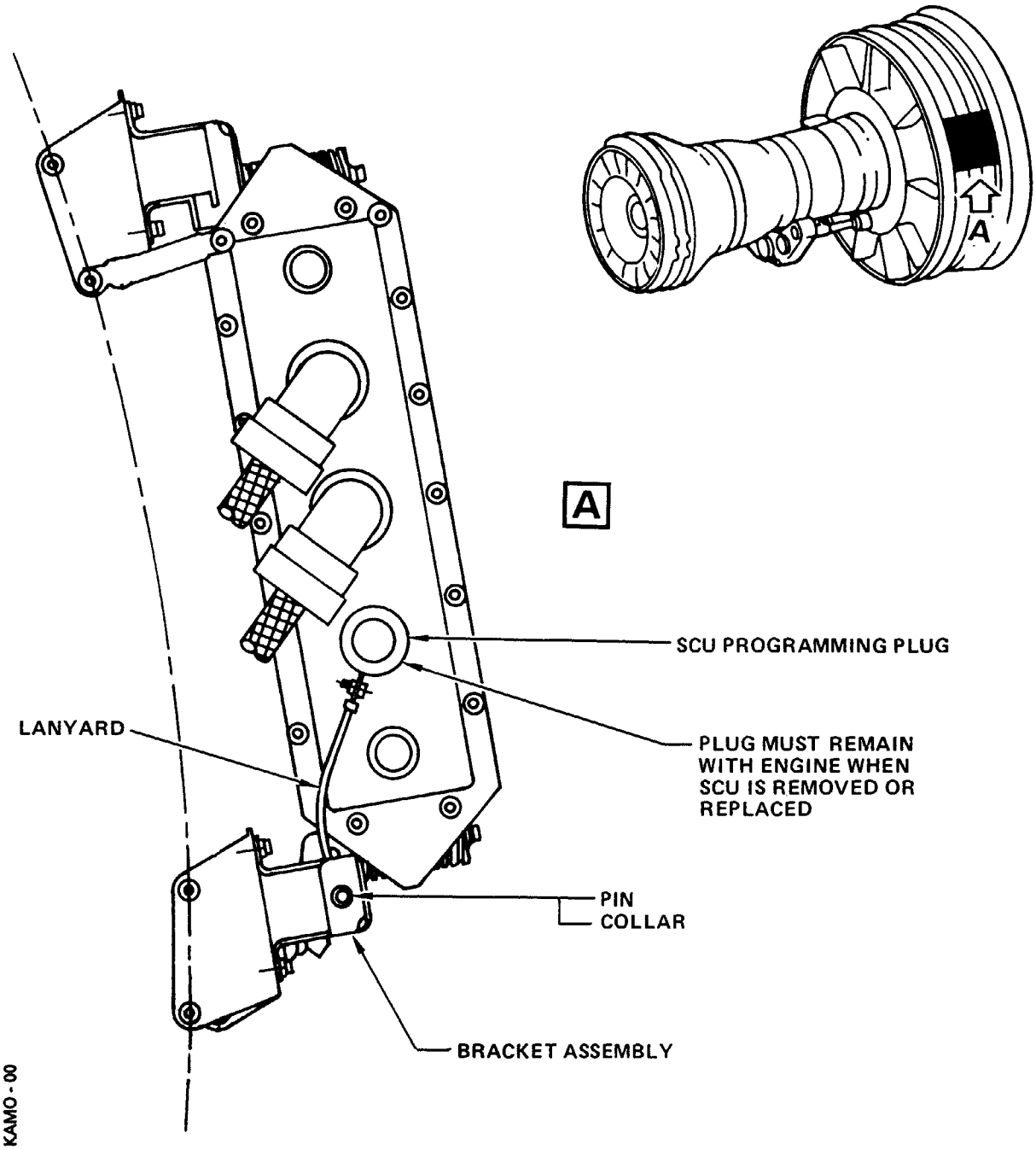
NOTE : Inside the programming plug, the engine serial number is identified (by electronics) to a specified engine (by serial number). Programming plugs are not interchangeable with each other unless a new plug is made to the same engine serial number.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH

CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(1)Install the SCU programming plug to the connector on the SCU (Ref. 70-00-00, P. Block 201) (same as electrical harness connector installation procedure).
(2)Attach the lanyard to the lower (rearward) mount bracket for the SCU with a rivet pin and collar.

D. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close right fan cowl door (Ref. 71-13-00, P. Block 301).
(3)Remove access platform.
(4)Remove safety clips and tags and close circuit breakers 34KS, 35KS, 36KS, 37KS.
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



REAR VIEW OF CONTROL AND ASSOCIATED MOUNTING PARTS AT FLANGE B1

L-A7113

SCU Programming Plug
Figure 401

FUEL METERING UNIT - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

The fuel metering unit provides the following functions : metered fuel flow to the engine as scheduled by the FADEC, engine minimum and maximum fuel flow settings, engine start and shut-down, and fine-filtered supply pressure for the engine control system torque motors and hydraulic actuators. The latter include actuators which control the compressor stator vanes and bleeds, the turbine case cooling, and the engine and IDGS valves for the air/oil coolers. The unit is mounted directly to the engine fuel pump. It contains the following major components : a 40 micron wire mesh inlet filter ; metering valve, pressure regulating valve (PRV), pressure regulator, overspeed solenoid, start and run solenoid shutoff solenoid, windmill bypass valve (WMBPV), minimum pressure and shut-off valve (MPSOV), sequence valve, torque motor and two dual coil resolvers.

Engine start or shutdown is accomplished with the use of the start/run solenoid and the shutoff solenoid to direct fuel pressure to position the sequence valve.

A spring-loaded sequence valve, positioned by a cam on the shaft, controls operation of the minimum pressure and shut-off valve (MPSOV) and windmill bypass valve (WMBPV).

During engine shut down or engine windmilling, the MPSOV is closed the WMBPV by-passes flow to pump interstage and maintains minimum pressure for control of engine variable geometry and for operation of the engine and IDGS oil cooling functions.

Engine fuel flow is scheduled by a FADEC supplied command signal to a torque motor which controls the position of the metering valve. Metering valve position is sensed by shaft mounted dual resolvers. When the metering valve is at the requested position (fuel flow), the FADEC commands the torque motor to modulate the metering valve to maintain the requested flow.

2. Major Components (Ref. Fig. 002, 001)

A. Filter

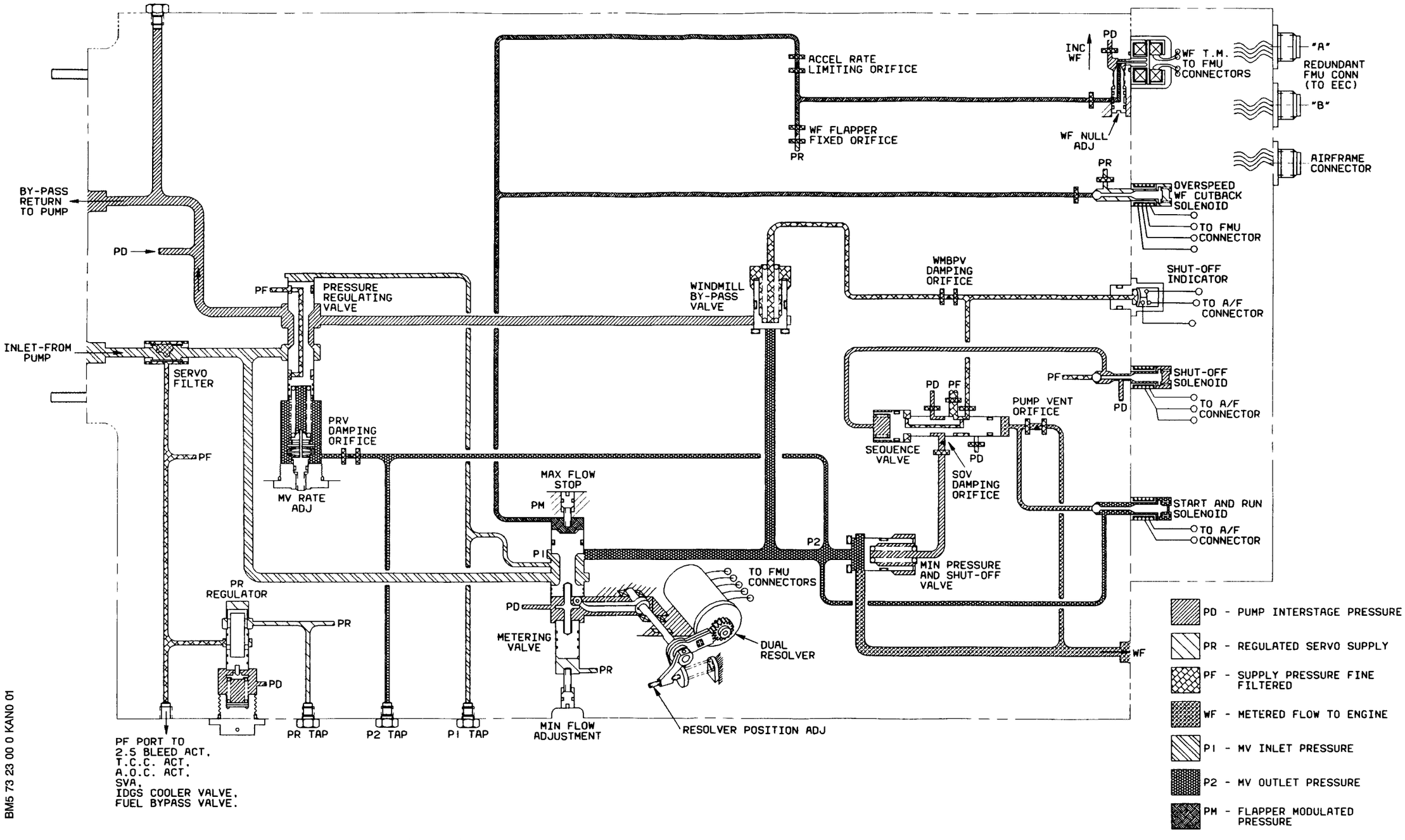
The inlet filter to the fuel metering unit is a line replaceable wire mesh wash type filter that provides clean flow for the pressure regulating valve, pressure regulator and hydraulic flow for positioning engine stator vanes, compressor bleeds, and turbine case cooling control and the actuators controlling cooling air to the engine and IDGS air/oil coolers.

B. Pressure Regulator

The PR regulator supplies the fine filtered flow to the torque motor nozzle, and metering valve at a constant 260 psi above drain pressure. The PF port supplies muscle pressure to the intercompressor (2.5) bleed actuator, turbine case cooling actuator, air/oil cooler actuator, stator vane actuator and IDG air/oil cooler actuator.

Engine flow then passes through the metering valve, and excess flow is returned to the pump by the pressure regulating valve (PRV). The pressure regulating valve senses metering valve upstream pressure (P1) and downstream pressure (P2) and varies the amount of fuel flow it by-passes to hold the pressure difference between P1 and P2 constant. The P1-P2 level is

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Fuel Metering Unit
Figure 001

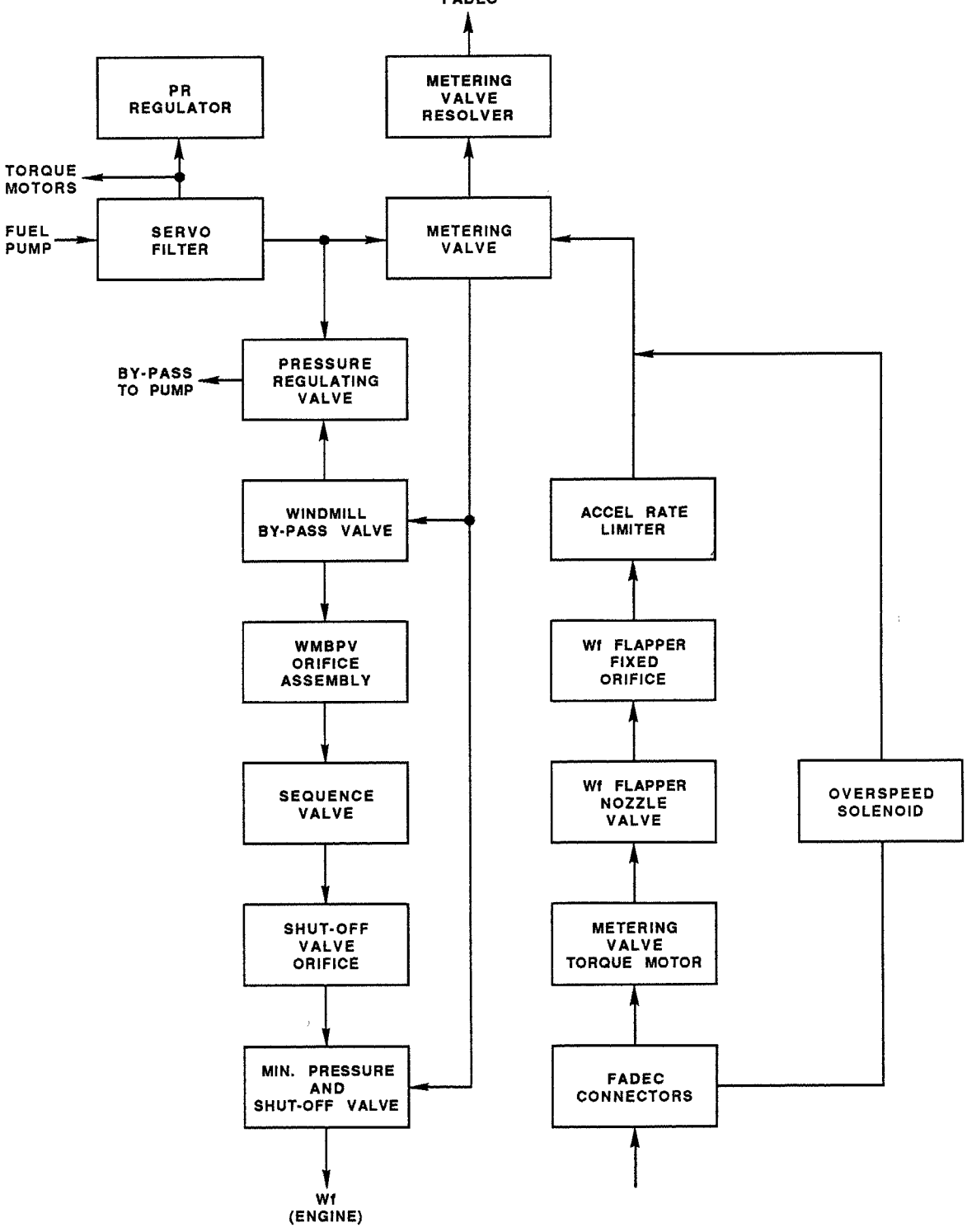
changed with fuel temperature by bi-metallic discs acting on the pressure regulating valve spring.
The effect is to keep the metering valve mass flow constant at each valve displacement regardless of fuel density changes due to temperature. A screw in the valve cap allows spring force to be changed to provide a rate adjustment on metering valve gain. Damping is provided by a screened orifice.

C. Metering Valve
The metering valve is a half-area-servo type valve. Regulated servo pressure (PR) acting on a half area piston is balanced by a modulated pressure (PM) acting on the valve area. Engine fuel flow is scheduled by an FADEC supplied command signal to a torque motor which controls the position of the wf flapper gap. Metering valve velocity is controlled by varying PM with the flapper described above. As the flapper strokes, modulated pressure to the metering valve changes. This causes metering valve position to change which directly changes the fuel flow metering window area. A spring-loaded feedback lever picks up metering valve position. The single-shaft dual resolvers input feedback lever rotational position to the FADEC in the form of an electrical signal to close the loop. When the metering valve is at the correct fuel flow position, the FADEC returns the torque motor and the flapper to the null position. The metering valve slews as a function of torque motor current. The MV velocity range at a given torque motor current is a function of the variations in fuel temperature, hysteresis, and dimensions. A fixed orifice is included in the PM line to the metering valve to limit accel slew rates to an acceptable range.

D. Torque Motor
The FMU torque motor contains two coils. Each channel of the dual-channel commands one torque motor coil. During operation, the FADEC has only one channel active at a time. The torque motor is designed with a null bias. In the event of a loss of current from the FADEC, the torque motor will return to a zero position which under all tolerance conditions, drives the metering valve to the min flow stop.

E. Windmill Bypass Valve
The valve is installed between the metering valve and the control outlet to the engine. The windmill bypass valve (WMBPV) prevents high pressure operation of the system when the engine is not running but is still rotating the fuel pump. This condition occurs during engine windmilling during start prior to opening th shutoff valve, and any other time the control is in shut-off while the engine is turning. The valve is opened by a low pressure signal from the sequence valve and bypasses metered flow back to pump inlet. The WMBPV provides a minimum pressurizing function similar to the MPSOV described below. When not in use, the valve provides drop-tight sealing to prevent a leak of metered fuel flow.

F. Minimum Pressurizing and Shut-off Valve
The final valve in the main fuel flow path is the minimum pressurizing and shut-off valve (MPSOV). The valve is installed between the metering valve and the control outlet to the engine.



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Fuel Metering Unit Functional Block Diagram
Figure 002

The MPSOV spring is sized to maintain a minimum control inlet pressure level of 300 psi above drain pressure. This pressure is required for normal operation of the control servo systems. The MPSOV windows are contoured to provide stability at low fuel flows. At shutdown, the valve closes providing drop-tight sealing of the engine fuel flow path.

G. Overspeed Solenoids

High and low rotor overspeed protection is provided by the overspeed cut back solenoid. When the FADEC detects an overspeed, the solenoid is energized. This provides regulated pressure to drive the metering valve to minimum flow.

FUEL METERING UNIT - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Corrosion Resistant Steel Lockwire (MS20995C32 and AS3214-02) (Ref. 70-00-00)
C.	Container Minimum Capacity of 5 U.S. Gallons (19 Liters)
D.	Packings
E.	Protective Closures
F.	Warning Notice
R G. GS21463-2	Closure Kit
H. Material No.P03-001	Oils (Ref. 70-00-00)
J. Material No.P03-002	Oils (Ref. 70-00-00)
K. Material No.P03-006	Oils (Ref. 70-00-00)
L. Material No.P06-002	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 70-00-00, P. Block 201	Engine Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-01, P. Block 401	Fuel Pump
- 73-23-00, P. Block 301	Fuel Metering Unit

2. Procedure

A. Job Set-Up

(1) Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301). Make certain that electronics rack ventilation is correct.

(2) On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(3) Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	FIRE EXTING/ENG1 & 2/SQUIB B/BTL1	5WE	207/C19
22VU	FIRE EXTING/ENG1 & 2/SQUIB B/BTL2	7WE	207/C20
133VU	ENGINES/ENG2/REVERSE/CTL	2KM	331/V74
133VU	ENGINES/ENG1/REVERSE/CTL	1KM	332/U69
133VU	ENGINES/ENG1/FUEL HP VALVE/WARN	1KC	333/T68
133VU	ENGINES/ENG1/FUEL HP VALVE/CTL	3KC	333/T69
133VU	ENGINES/ENG2/FUEL HP VALVE/CTL	4KC	333/T70
133VU	ENGINES/ENG2/IGNITION/SYS A	8JH	333/T71
133VU	ENGINES/ENG1 & 2/IGNITION/SYS B	2JH	333/T72
133VU	ENGINES/ENG1/IGNITION/SYS A	1JH	334/S72
133VU	ENGINES/ENG1 & 2/START/CTL & WARN	1KG	335/R68

PANEL	SERVICE	IDENT.	LOCATION
133VU	ENGINES/ENG1 & 2/FIRE EXTING/SQUIB A/ BTL 1	1WE	335/R71
133VU	ENGINES/ENG1 & 2/FIRE EXTING/SQUIB A/ BTL 2	3WE	335/R72
133VU	ENGINES/ENG2/FUEL HP VALVE/WARN	2KC	335/R73

(4)Open right fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(5)Disconnect the DH10 connector from the electrical connector on the inboard side of the fuel metering unit.
(6)Install protective closures.

B. Removal (Ref. Fig. 401)
NOTE : This procedure is for removal of the fuel metering unit from the fuel pump while fuel pump remains on engine. For removal of fuel pump and fuel metering unit as a package (Ref. 73-12-01, P. Block 401).
(1)Drain residual fuel from fuel metering unit by removing lockwire and plug from port (FP3) adjacent to fuel filter on fuel pump. Discard packing.
NOTE : Be prepared to catch fuel in container with a minimum capacity of 5 U.S. gallons (19 liters).
(2)Using new packing, lubricated with Material No.P06-002, reinstall plug. TORQUE plug to between 45 and 55 lbf. in. (0.51 and 0.62 m.daN). Wirelock plug.
(3)Remove lockwire from compressor stator cylinder hydraulic manifold assembly and disconnect manifold from adapter on fuel metering unit, from tee on stator vane actuator manifold assembly, and from fuel bypass valve. Remove manifold from engine.
(4)Disconnect W5P1 and W4P2 harness connectors. Install protective closure on each harness and each fuel metering unit connector.
R (5)If equipped with the fuel metering unit integral actuator, disconnect
R the DH10 connector from the electrical connector on the inboard side
R of the fuel metering unit. Install protective closures.
R (6)Remove lockwire and disconnect fuel distribution valve supply tube assembly from adapter on fuel metering unit and from adapter on fuel flowmeter.
R (7)Remove bolts, nut, and clamps securing tube to HPC case bracket and airframe cooler oil outlet tube. Remove tube from engine. Discard packings and retainers.
R (8)Remove nuts and washers securing fuel metering unit to fuel pump. Remove fuel metering unit from pump.
(9)Remove the transfer tubes from the fuel pump as follows :
R (a)In the following steps, look for bronze or bronze colored particles
R on the transfer tubes and/or the servo wash filter when you separate
R the fuel metering unit from the fuel pump.
R 1 If you find bronze (contamination) you must replace the fuel
R metering unit and the fuel pump. You must monitor the servo

R fuel driven components for dual "Track Check" faults. Refer
R to the TSM. If dual "Track Check" faults occur, you must
R take the necessary maintenance action to find the cause.
R (b)Remove the packings from fuel pump transfer tubes.
R (c)Remove the retainers that hold the transfer tubes in the fuel pump.
R (d)Remove the transfer tubes from the fuel pump and remove the packings from the inner grooves of the transfer tubes.

(10)Install protective closures.

(11)If new fuel metering unit is to be installed, do as follows :

(a)Remove threaded adapter from port on inboard side of fuel metering unit and discard packing.

(b)Remove bolts and bracket securing adapter to fuel supply port on outboard side of fuel metering unit and remove adapter from port. Discard packing.

CAUTION : FUEL METERING UNITS WHICH WILL NOT BE INSTALLED ON ENGINES WITHIN 24 HOURS AFTER REMOVAL MUST BE PRESERVED TO PREVENT INTERNAL CORROSION.

(12)If fuel metering unit will not be installed on engine within 24 hours. Do the preservation procedure as follows :

(a)Drain all the remaining fuel from the fuel metering unit.

(b)Install a closure kit, GS21463-2, on the inlet and outlet ports.

(c)Fill the fuel metering unit with sufficient Material No.P03-002 or P03-006 to apply a layer of oil on all areas which are usually open to fuel.

NOTE : Fill the fuel metering unit with oil through the transfer tube ports.

(d)Shake (agitate) the fuel metering unit to make sure that all internal parts get a large quantity of oil.
Drain excess oil from the fuel metering unit.

(e)Install the remaining protection covers to the fuel metering unit.

C. Installation (Ref. Fig. 401)

CAUTION : TO PREVENT INDUCING LOADS INTO THE DRIVE PAD CARBON SEAL, CARE SHOULD BE TAKEN TO PROPERLY ALIGN AND SUPPORT THE COMPONENT DURING INSTALLATION.

(1)If new fuel metering unit is being installed, do as follows.

(a)Install new packing lubricated with Material No.P06-002, to adapter and install adapter and bracket to fuel supply port on fuel metering unit. Secure with four bolts, threads lubricated with Material No.P03-001. One of four bolts with lockwire holes to be installed in bottom outboard adapter bolthole.
TORQUE bolts to between 65 and 85 lbf. in. (0.73 and 0.96 m.daN).

(b)Install new packing lubricated with Material No.P06-002, to adapter and install adapter, threads lubricated with Material No.P03-001, to port on fuel metering unit. TORQUE adapter to between 200 and 225 lbf. in. (2.25 and 2.54 m.daN).

(2)Install the transfer tubes to the fuel pump as follows :

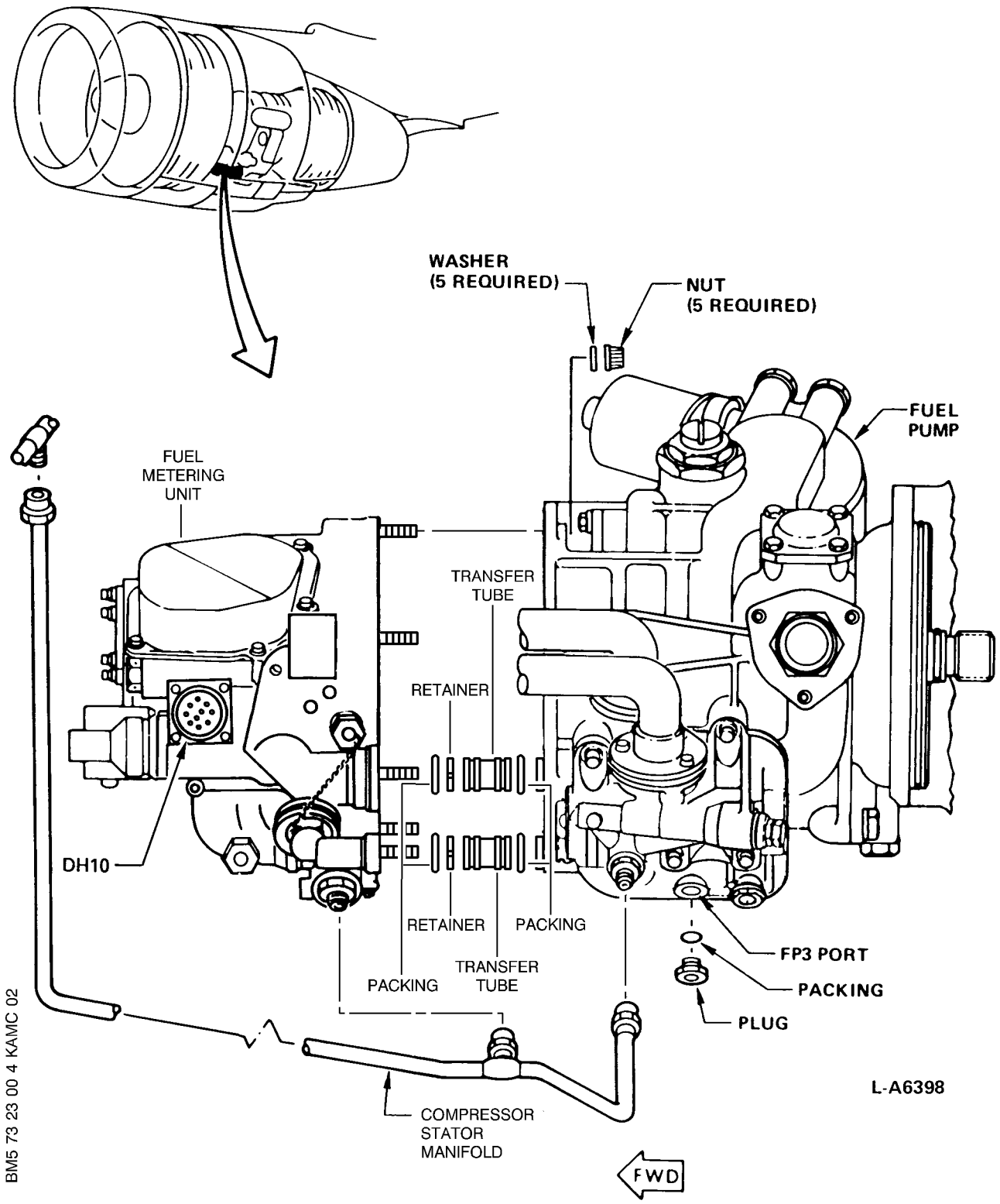
(a)Lubricate two new small packings and two new large packings with Material No.P06-002.

(b)Install one packing to both of the transfer tubes.

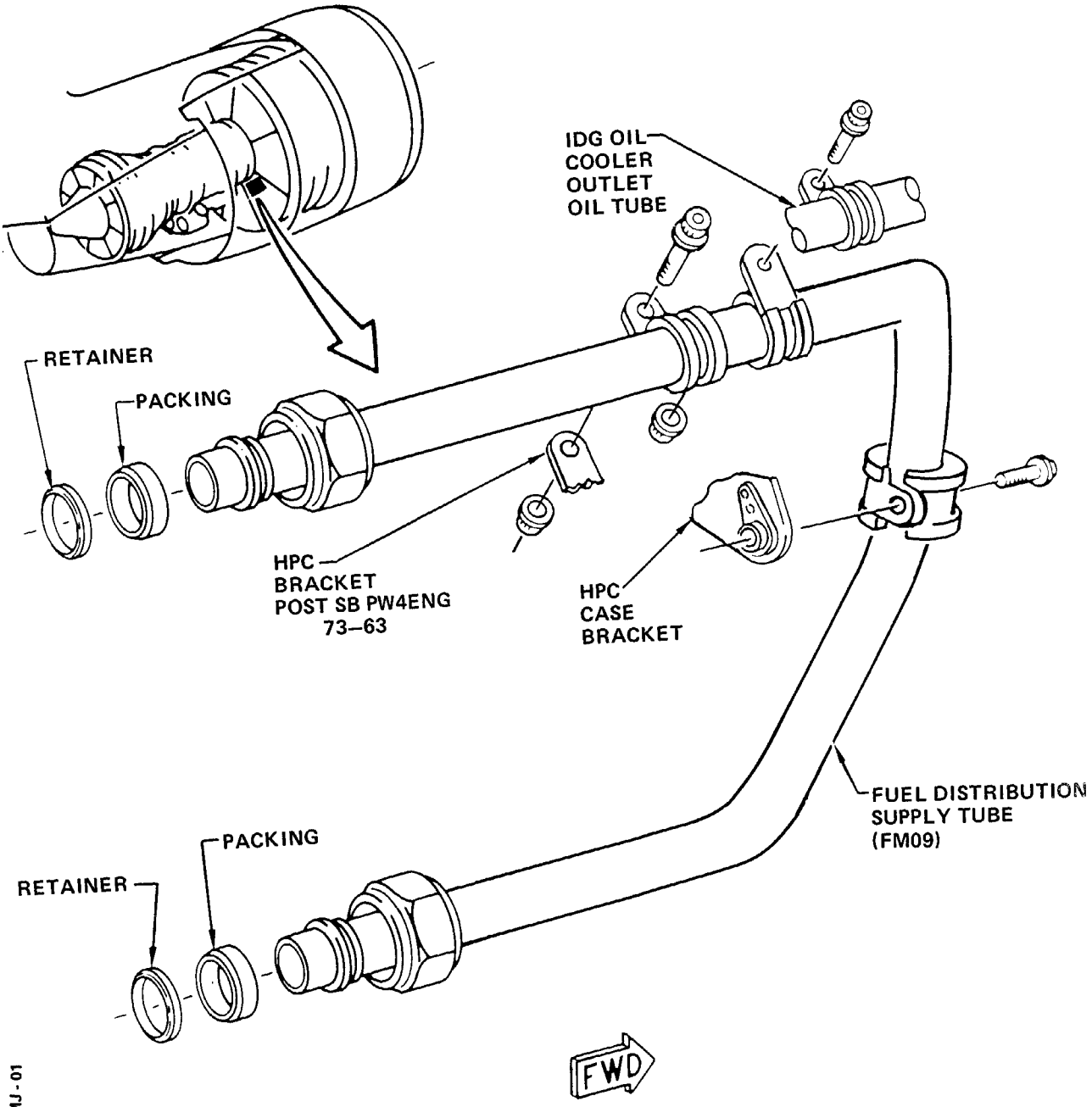
(c)Install the transfer tubes, packing side inward, to the fuel pump

ports.
(d)Install the retainers to hold the transfer tubes in position in the fuel pump.
(e)Install the remaining packings to the transfer tubes on the fuel pump.
(3)Lubricate threads of fuel metering unit studs with Material No.P03-001, and install fuel metering unit to fuel pump over transfer tubes and secure with washers and nuts. TORQUE nuts to between 275 and 300 lbf. in. (3.11 and 3.34 m.daN).
(4)Install packings lubricated with Material No.P06-002, and retainers to fuel distribution valve supply tube assembly. Attach tube to adapters, threads lubricated with Material No.P03-001, on fuel metering unit and flowmeter.
(5)Install bolts, threads lubricated with Material No.P03-001, nut, and clamps securing tube to HPC case bracket and to airframe cooler oil outlet tube. TORQUE bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(6)TORQUE tube nuts to between 100 and 110 lbf. in. (1.13 and 1.24 m.daN),
R loosen tube nuts to less than 10 lbf.in. (0.11 m.daN) then retorque to required limit. Wirelock tube nuts.
NOTE : Tube nut attached to fuel metering unit to be wirelocked to bolt securing adapter to fuel metering unit.
(7)Lubricate threads of fuel metering unit adapter with Material No.P03-001. Install compressor stator cylinder manifold to fuel bypass valve, fuel metering unit, and manifold tee.
TORQUE manifold nut to fuel bypass valve to between 200 and 225 lbf.in. (2.26 and 2.54 m.daN). TORQUE manifold nut to fuel metering unit to between 450 and 500 lbf.in. (5.08 and 5.65 m.daN).
TORQUE manifold nut manifold tee to between 340 and 375 lbf.in. (3.84 and 4.24 m.daN).
Wirelock tube nuts.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(8)Connect W4P2 and W5P1 harness connectors to fuel metering unit.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(9)If equipped with the fuel metering unit integral actuator, connect the DH10 connector to the electrical connector on the inboard side of the fuel metering unit (Ref. 70-00-00, P. Block 201).

D. Close-Up and Test
(1)Connect the DH10 connector to the electrical connector on the inboard



Fuel Metering Unit (Sheet 1/3)
Figure 401

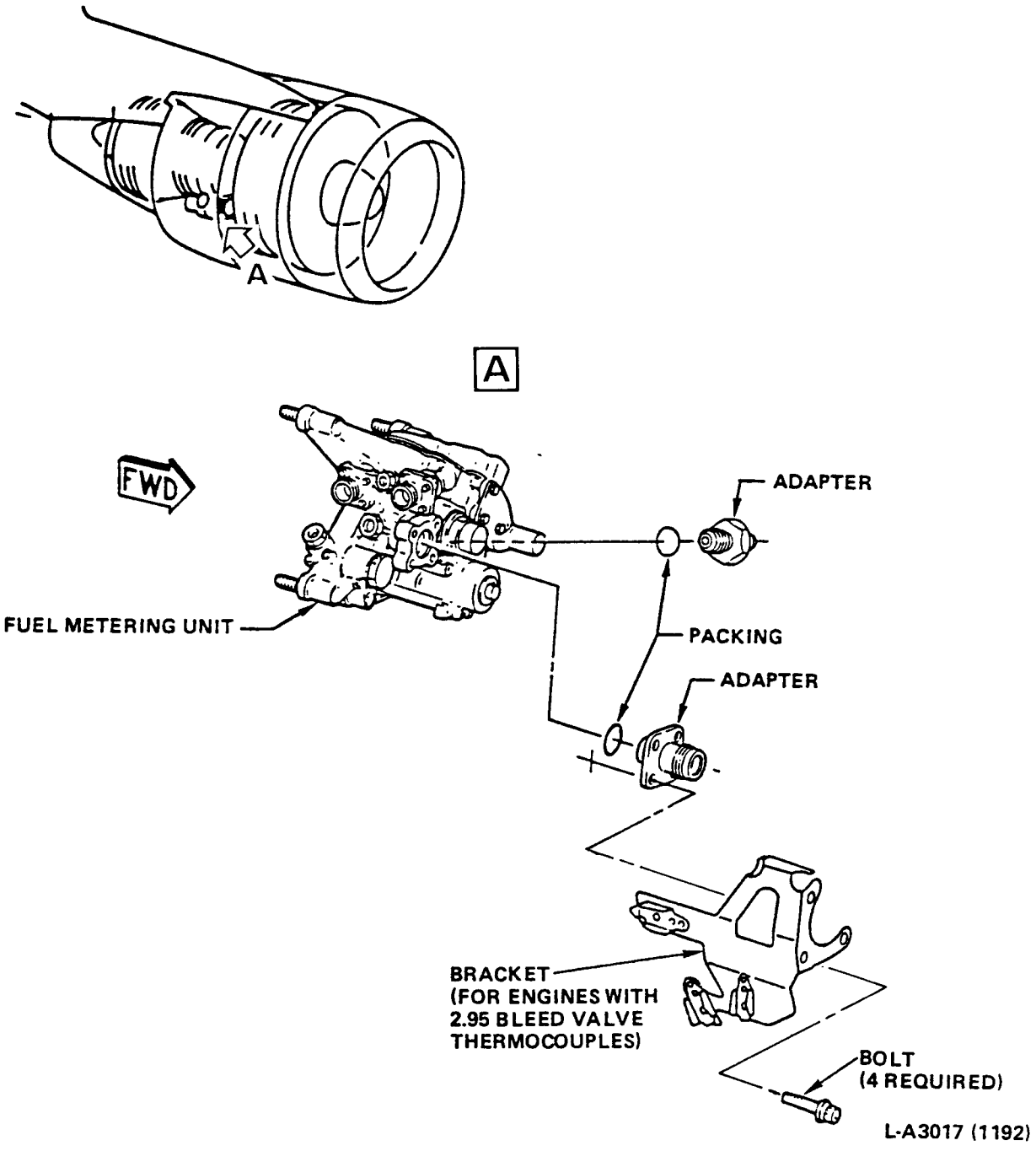


Fuel Metering Unit (Sheet 2/3)
Figure 401

side of the fuel metering unit.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(3)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(4)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(5)Remove safety clips and tags and close circuit breakers 1KM, 1KG, 2KM, 3KC, 4KC, 1JH, 2JH, 8JH, 1KC, 2KC, 1WE, 3WE, 5WE and 7WE.
(6)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).
(7)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).



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Fuel Metering Unit (Sheet 3/3)
Figure 401

FADEC SYSTEM COMPONENTS - DESCRIPTION AND OPERATION

1. Permanent Magnet Alternator

A. General (Ref. Fig. 001, 002)

Power to each electronic control channel is provided by a dedicated, dual channel alternator. The engine gearbox driven alternator has a speed range of 0-43, 000 rpm, which is a direct function of engine high rotor speed. The alternator is capable of powering the FADEC at approximately 5 % of engine high rotor speed.

The permanent magnet alternator consists of a rotor which mounts on a dry stub shaft protruding from the gearbox and a dual wound stator which mounts concentrically over the rotor. In addition, a separate speed winding provides a dedicated N2 speed signal directly to the flight compartment. total power provided by each output winding is approximately 60 watts. The alternator/cable assembly is cooled with fan discharge air.

B. Description

The rotor is mounted directly on the gearbox output shaft and the stator is bolted to the gearbox. The rotor contains twelve individual permanent magnets to generate the electrical power in an eighteen slot, three Phase Y connected stator.

The alternator provides two identical and independent power outputs one for each channel of the FADEC. The FADEC obtains its N2 speed input by sensing the frequency of the power input provided by the alternator. A separate stator winding provides a dedicated frequency signal for the N2 indicator and is designed to operate short-circuited indefinitely. The alternator is driven at 3.52 times N2 speed.

The stator and rotor are sealed from the gearbox by a shaft seal. If a shaft seal failure occurs and the alternator fills with engine oil, the alternator will continue to function normally.

2. FADEC Oil Temperature Thermocouple Probe (Ref. Fig. 003)

NOTE : Do not mistake the FADEC oil temperature thermocouple probe located on the gearbox at connector P18, for the oil temperature sensor located at DT 582 connector. For further description (Ref. 79-32-11, P. Block 401).

The oil temperature probe provides the FADEC with a thermocouple signal to permit control of fluid temperature.

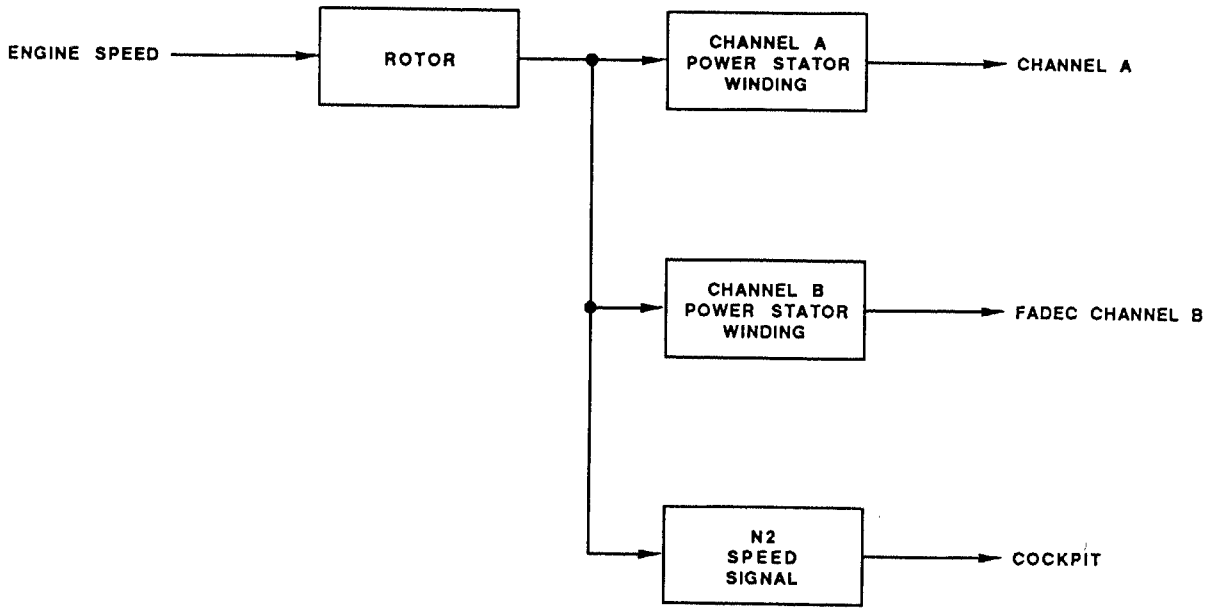
The probe consists of one chromel/alumel dual element thermocouple and terminates in a five pin connector which provides independent temperature signals to each channel of the FADEC.

The oil temperature probe is located in the gearbox oil scavenge passage and senses engine oil temperature returning from various engine lubrication areas.

3. FADEC Fuel Temperature Thermocouple Probe (Ref. Fig. 004)

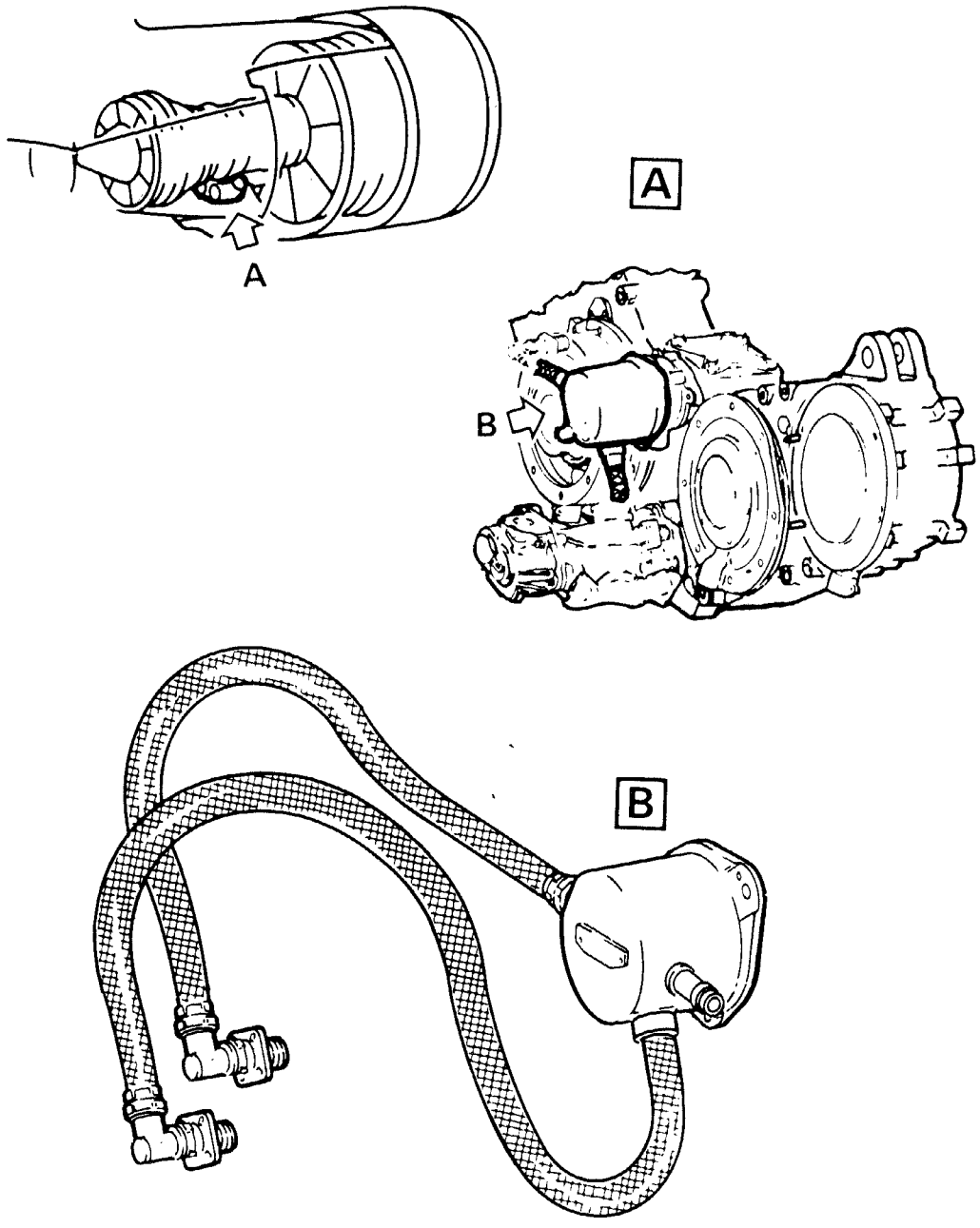
The fuel temperature probe provides the FADEC with a thermocouple signal to permit control of fluid temperature.

The probe consists of one chromel/alumel dual element thermocouple and terminates in a five pin connector which provides independent temperature



BM5 73 24 00 0 KAMO - 20

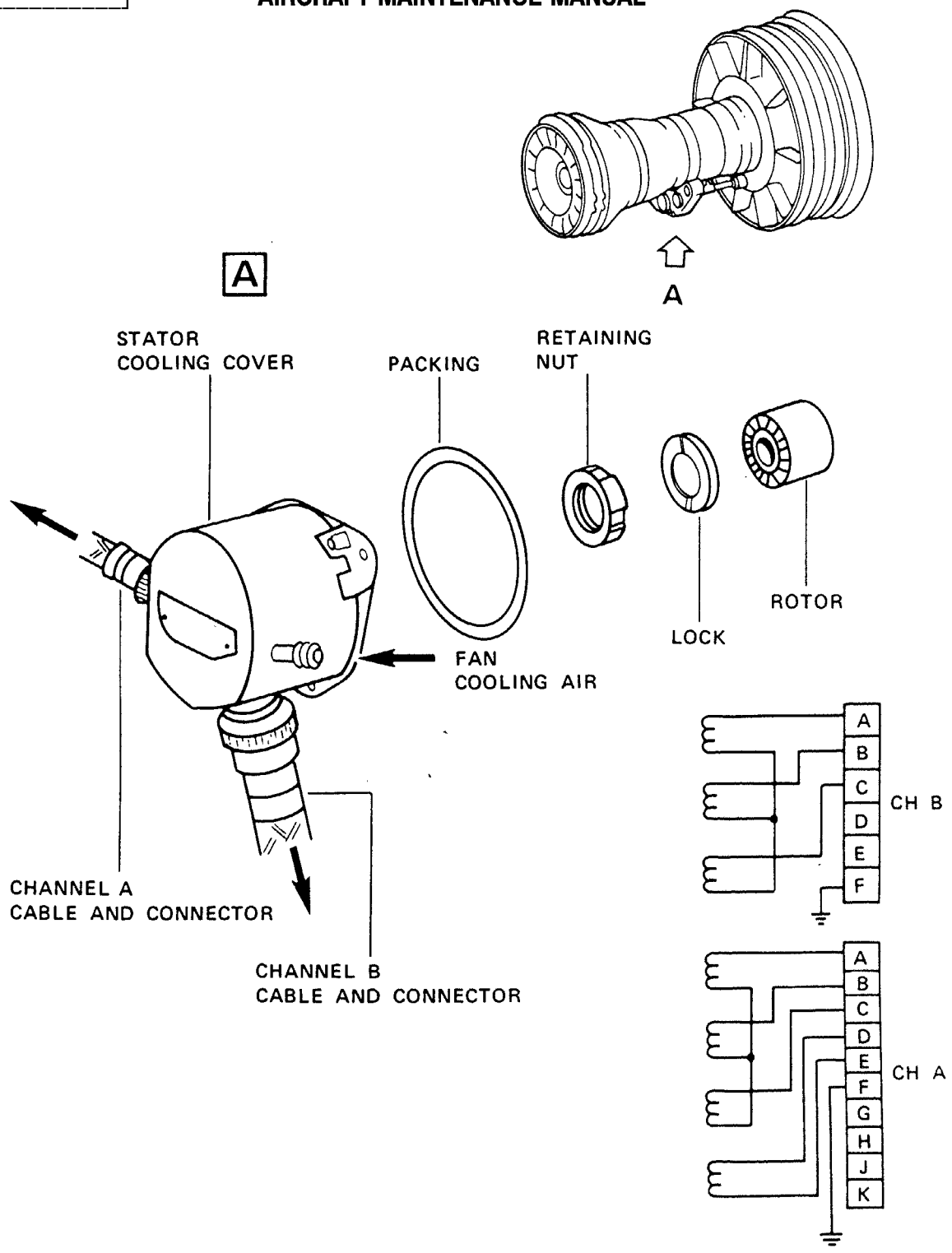
Alternator Functional Block Diagram
Figure 001



BM5 73 24 00 0 KEMA - 24 - 19
DM5

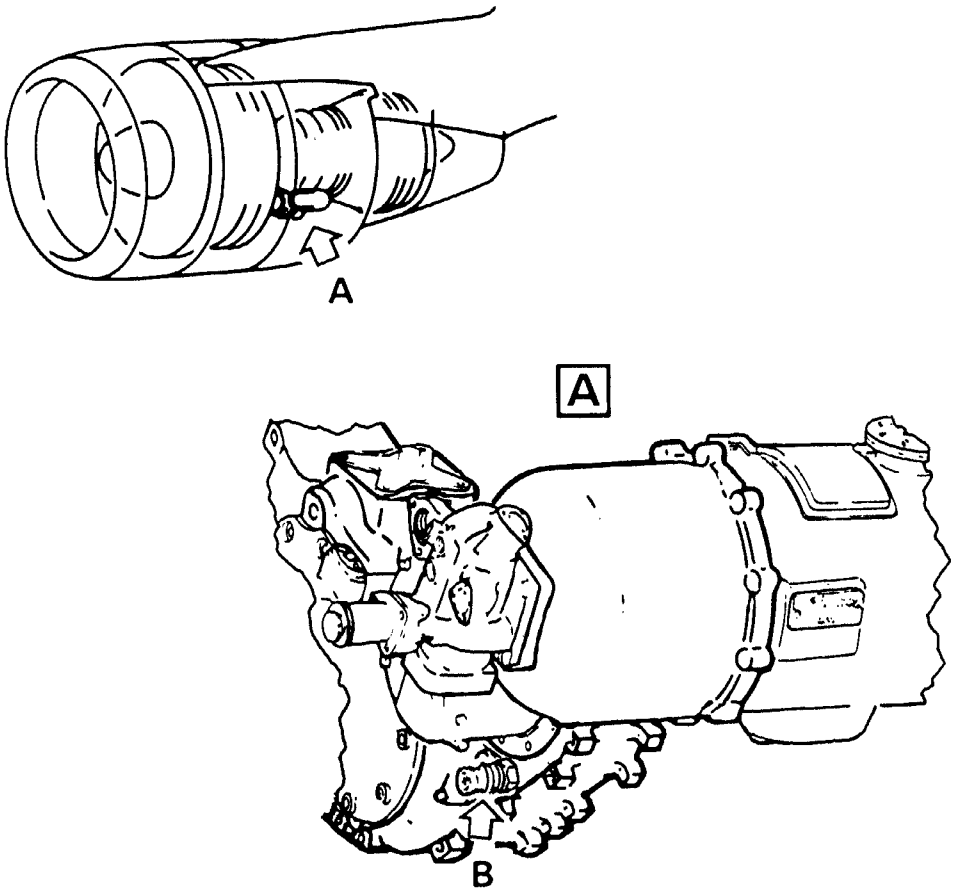
L-A4072

Permanent Magnet Alternator (Sheet 1/2)
Figure 002



BM5 73 24 00 0 KEMC - 24 - 19
DM5

Permanent Magnet Alternator (Sheet 2/2)
Figure 002



BM5 73 24 00 0 KGMO - 24 - 19
DM5

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Oil Temperature Probe
Figure 003

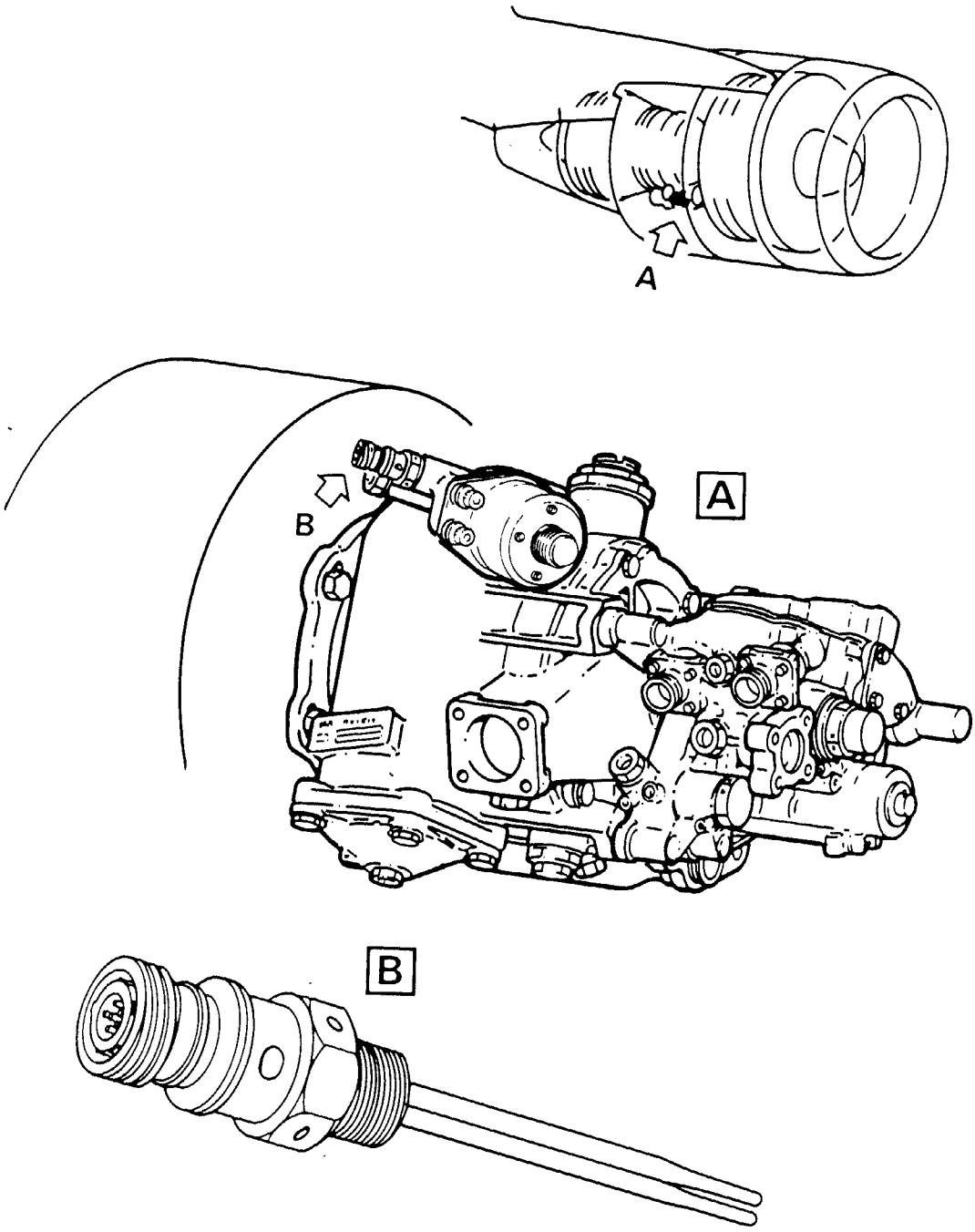
signals to each channel of the FADEC.
The fuel temperature probe is located in the fuel pump interstage passage to sense fuel temperature due to heat input from the fuel/oil cooler and/or fuel metering unit bypass flow.

4. FADEC N1 Speed Transducer (Ref. Fig. 005, 006)
The N1 speed transducer provides to the FADEC two identical and independent output frequency signals approximating sine waves, symmetrically around zero. The transducer is mounted in close proximity to 60 teeth machined on the low rotor shaft. Each output is used by its dedicated channel of the FADEC. The transducer consists of a permanent magnet, two electrically independent wire pick-up coils and two ferro-magnetic coil cores, enclosed in a non-magnetic steel case and mounted on a support tube assembly inserted through the intermediate case wall. Two electrically independent output voltage signals are carried through the support tube assembly by two pairs of shielded insulated wires which terminate at an electrical connector. The output voltage of each coil is a minimum 1.0 volts peak over a speed range of 200 to 4400 rpm.

5. FADEC Programming Plug (Ref. Fig. 007)
The FADEC programming plug consists of a 26-contact connector plug and a connector backshell. A lanyard provides a means of permanently attaching the programming plug to the engine. The plug identification is inscribed on the connector backshell. Pins (insulating) are installed in all unused contacts not occupied by electrical lead assemblies (jumper wires).
The plug is configured to establish a discrete data code to be read by the electronic engine control (FADEC) to which it is connected. This is accomplished by jumper wires installed on the rear of the plug assembly between selected contact pairs. The data plug defines the rating/schedule and EPR correction for each engine.

6. FADEC Inlet Pressure/Temperature (PT2/TT2) Probe (Ref. Fig. 008, 009)
The PT2/TT2 probe is located near the 12 O'clock location of the nose cowl, and measures total temperature and pressure in the inlet air stream of the engine forward of the engine front flange. The dual output total temperature measurement is provided by two platinum resistance-sensing elements. Each channel of the FADEC monitors one of these platinum resistance elements to convert the resistance measurement into a temperature signal.
The total gas pressure measurement is provided by the probe to one of the Channel A pressure transducers in the FADEC. The output of the pressure transducer is hardwired to both channels. The probe has an anti-icing provision by means of an electrical heating element. The heater is a hermetically sealed coaxial resistance element brazed internally into the housing casting. It uses 115/400 Hz power and consumes up to 450 watts. Heater induced errors to TT2 temperatures are corrected in the FADEC software.

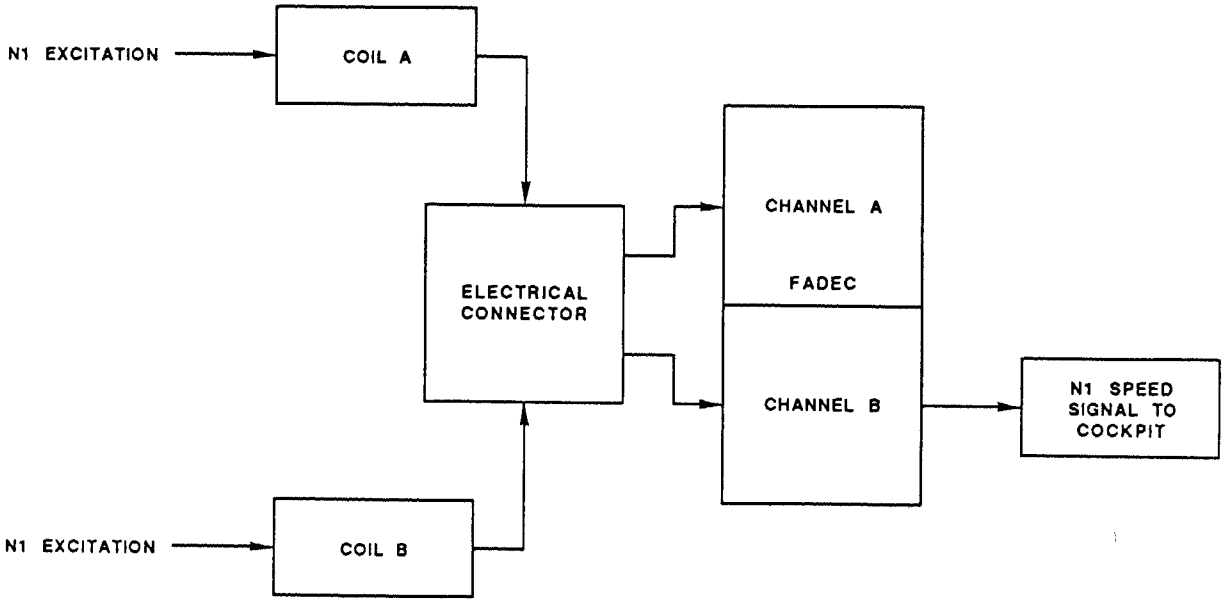
7. Other Components
Some other engine components interfacing with the FADEC are not described in this document but in the following System Description Notes :
- Stator Vane, Turbine Case Cool, Intercompressor bleed 2.5, Start/Stability bleed, Thermatic Rotor Control, Turbine Cooling Air (Ref. 79-00).



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DM5

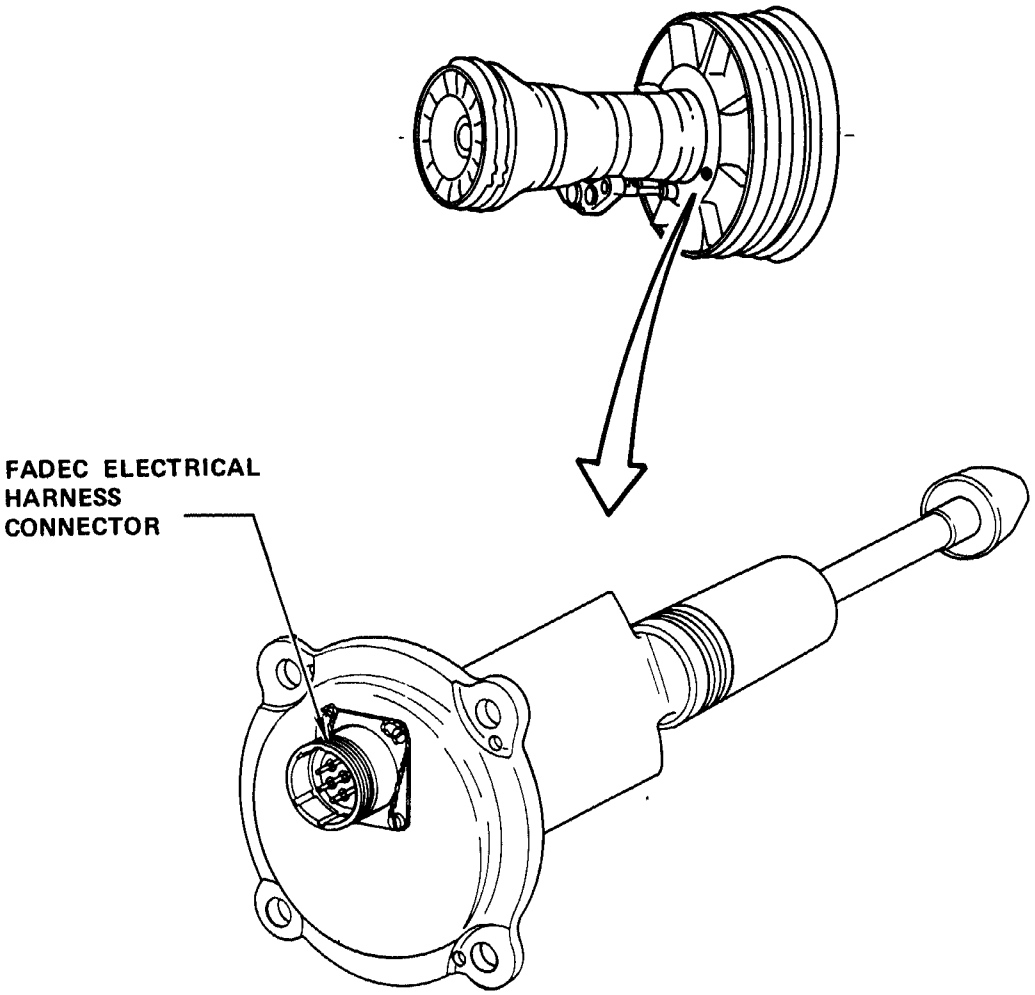
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Fuel Temperature Probe
Figure 004



BM5 73 24 00 0 KKMO - 20

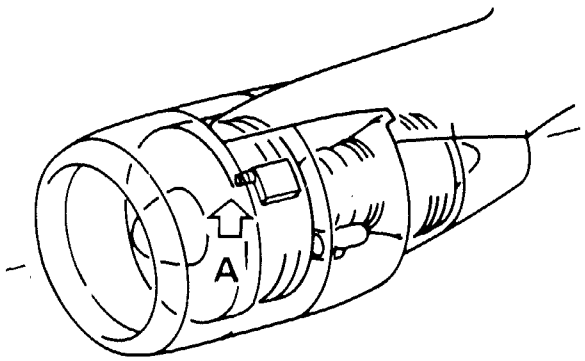
N1 Transducer Functional Block Diagram
Figure 005

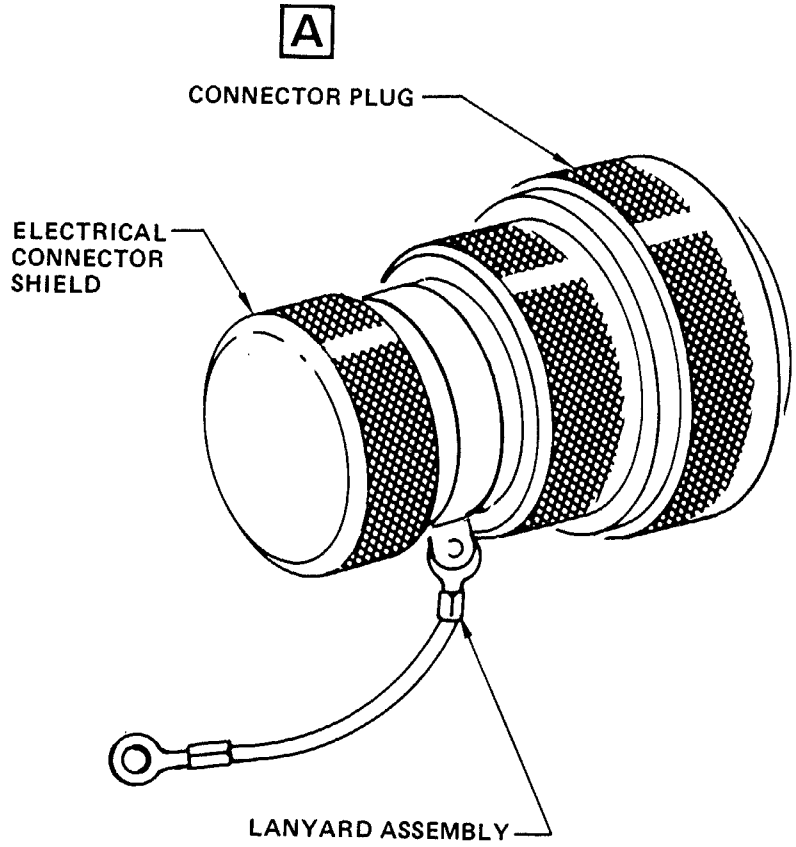


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L—A0222

FADEC Speed Transducer
Figure 006

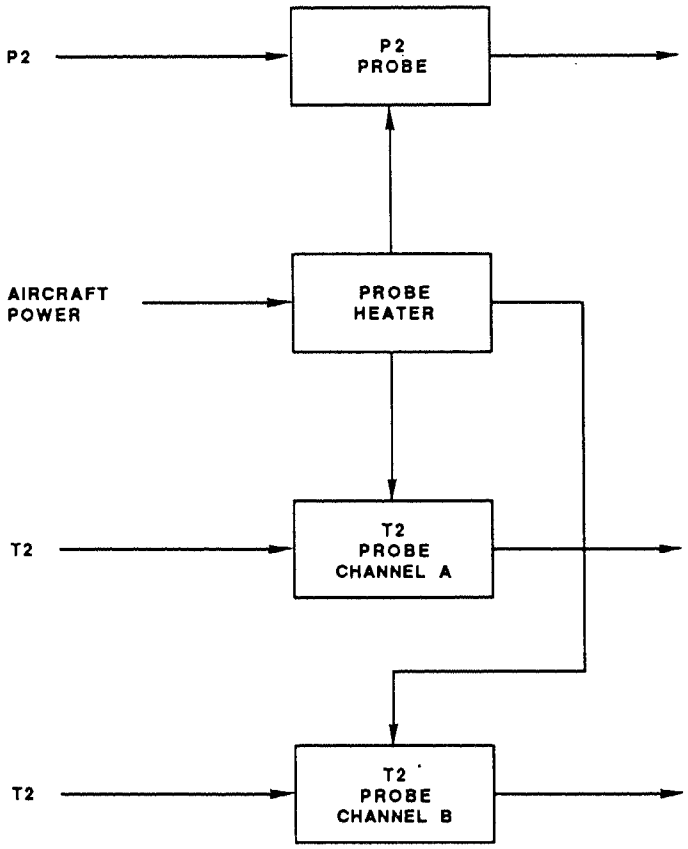




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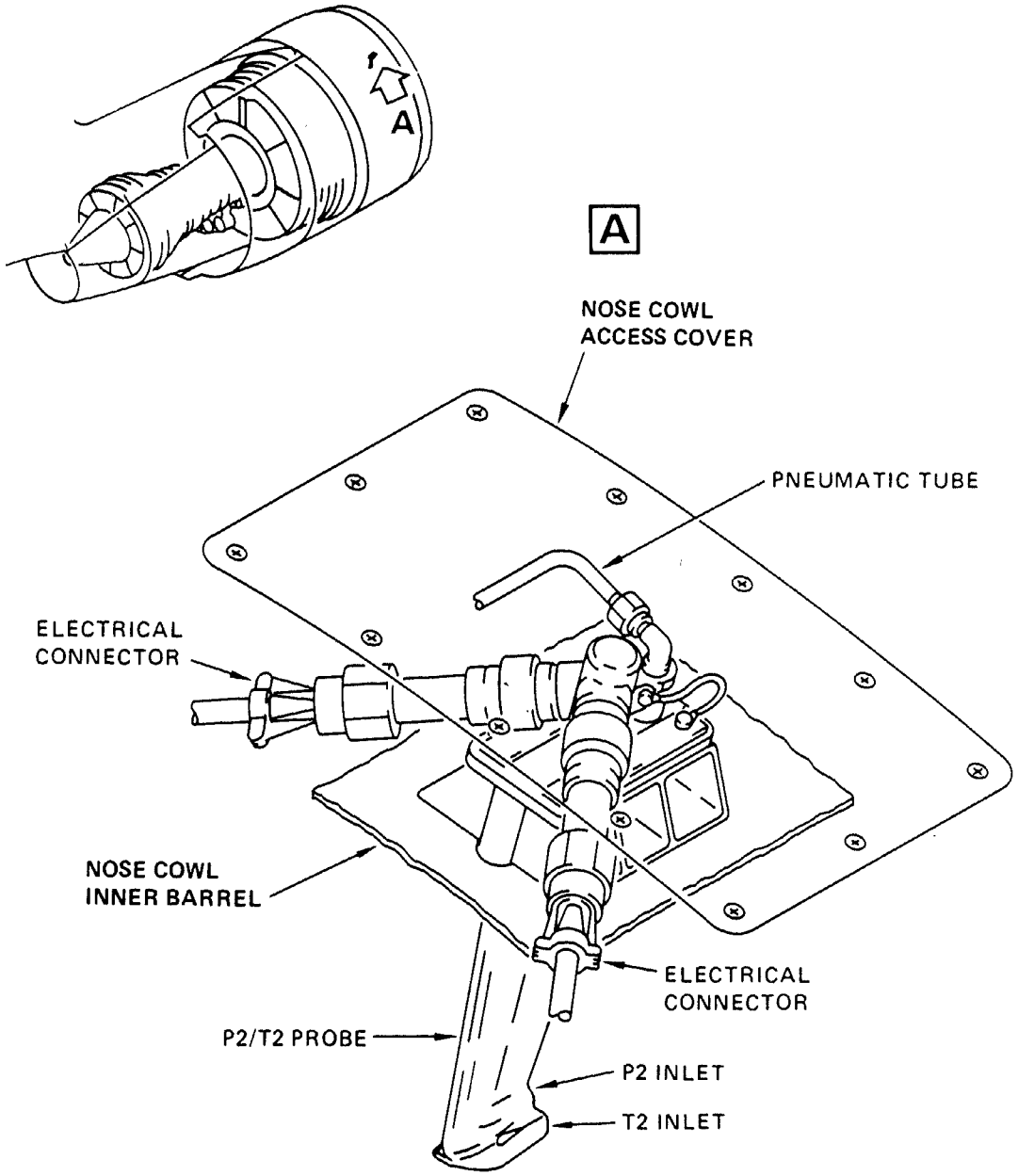
BM5 73 24 00 0 KNMO - 24 - 19
DM5

FADEC Programming Plug
Figure 007



BM5 73 24 00 0 KNNO - 20

T2/P2 Probe Functional Block Diagram
Figure 008



BM5 73 24 00 0 KPMO - 24 - 19
DM5

L-A233R
8-87

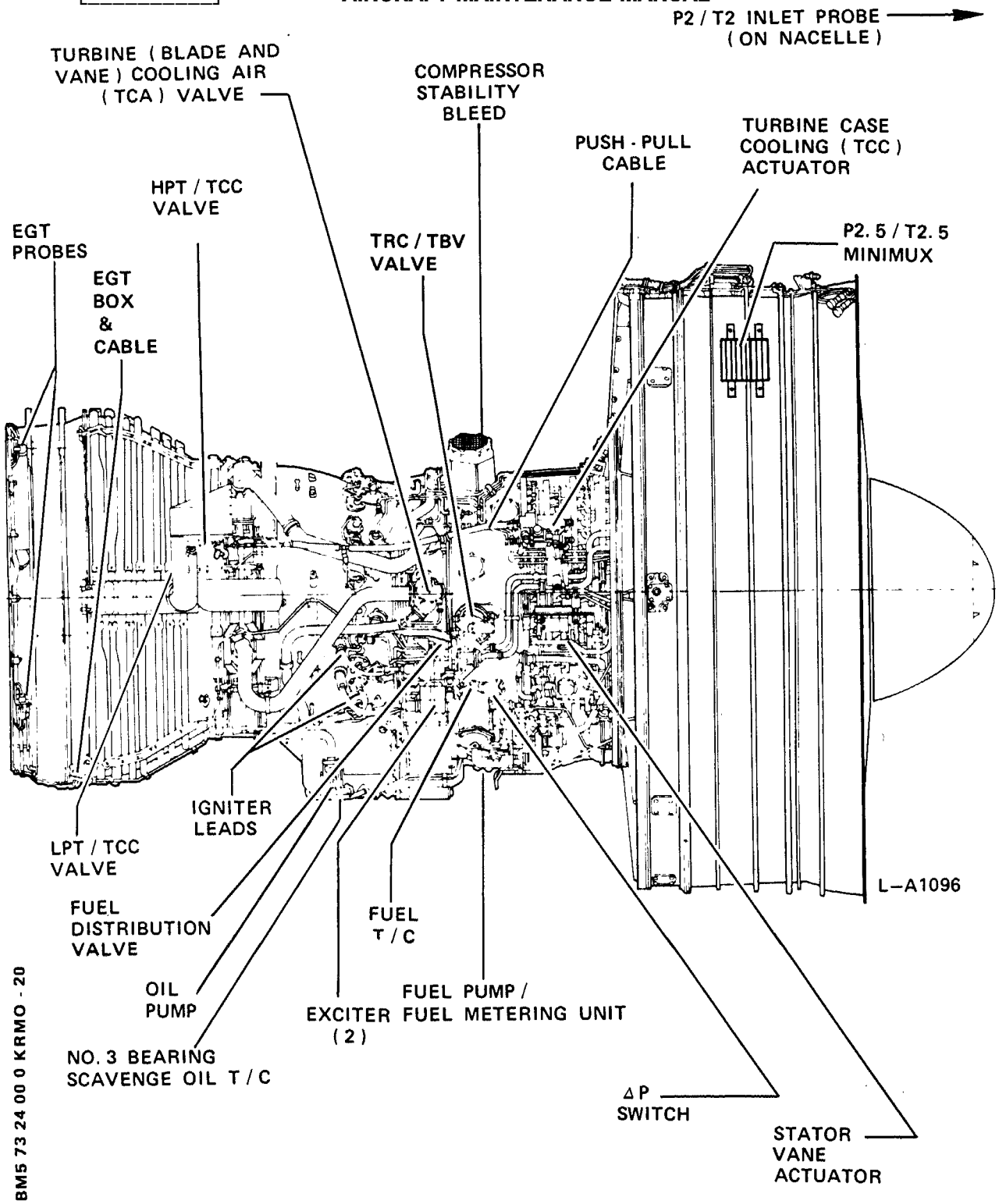
FADEC Inlet Pressure/Temperature (PT2/TT2) Probe
Figure 009

- Engine Air Oil Heat Exchanger (Ref. 79-00).

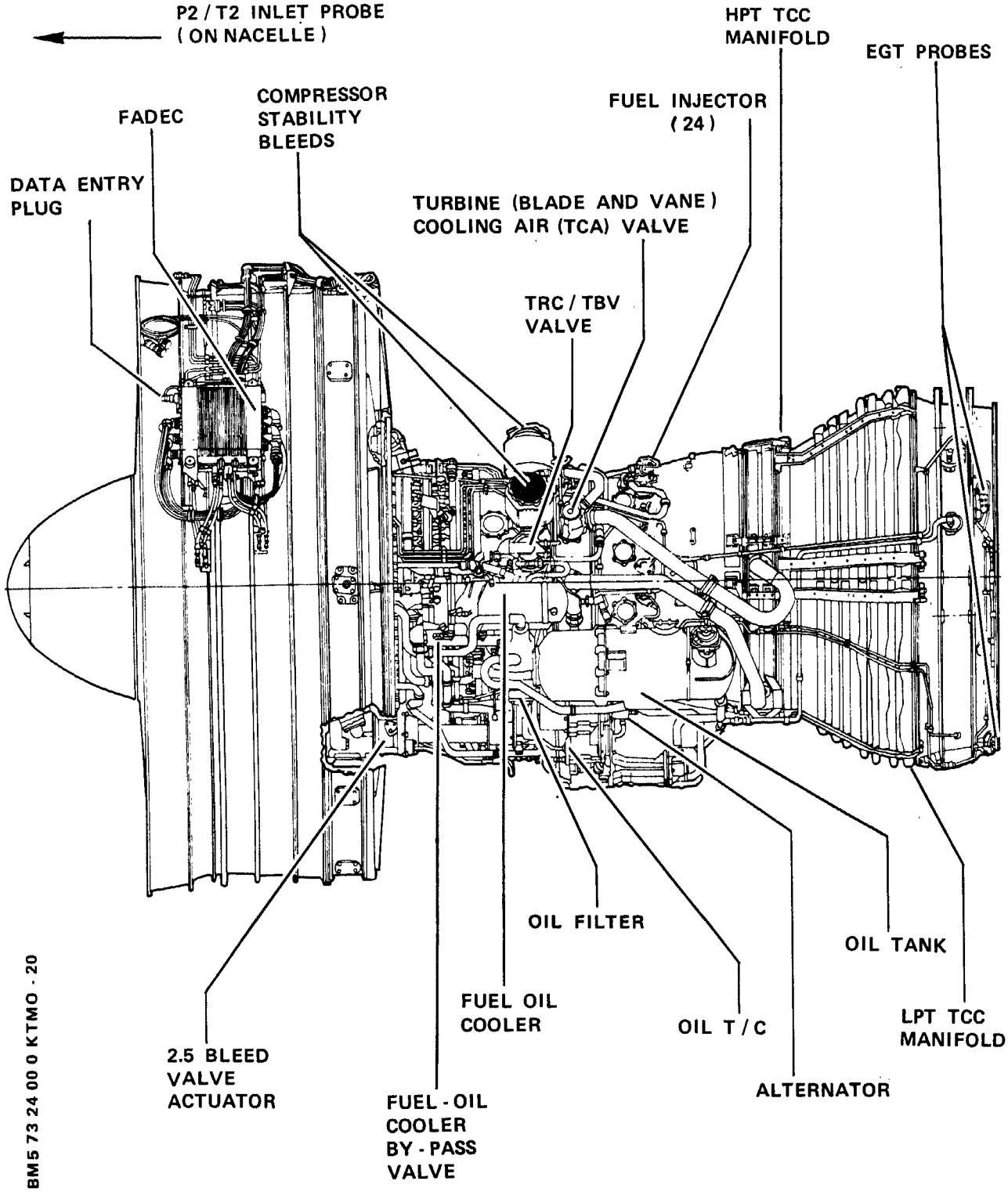
The FADEC functions corresponding to these interfaces are described in chapter 73-25 (FADEC system interface with Engine and Nacelle/Functions).

8. Component Location on Engine (Ref. Fig. 010, 011, 012)

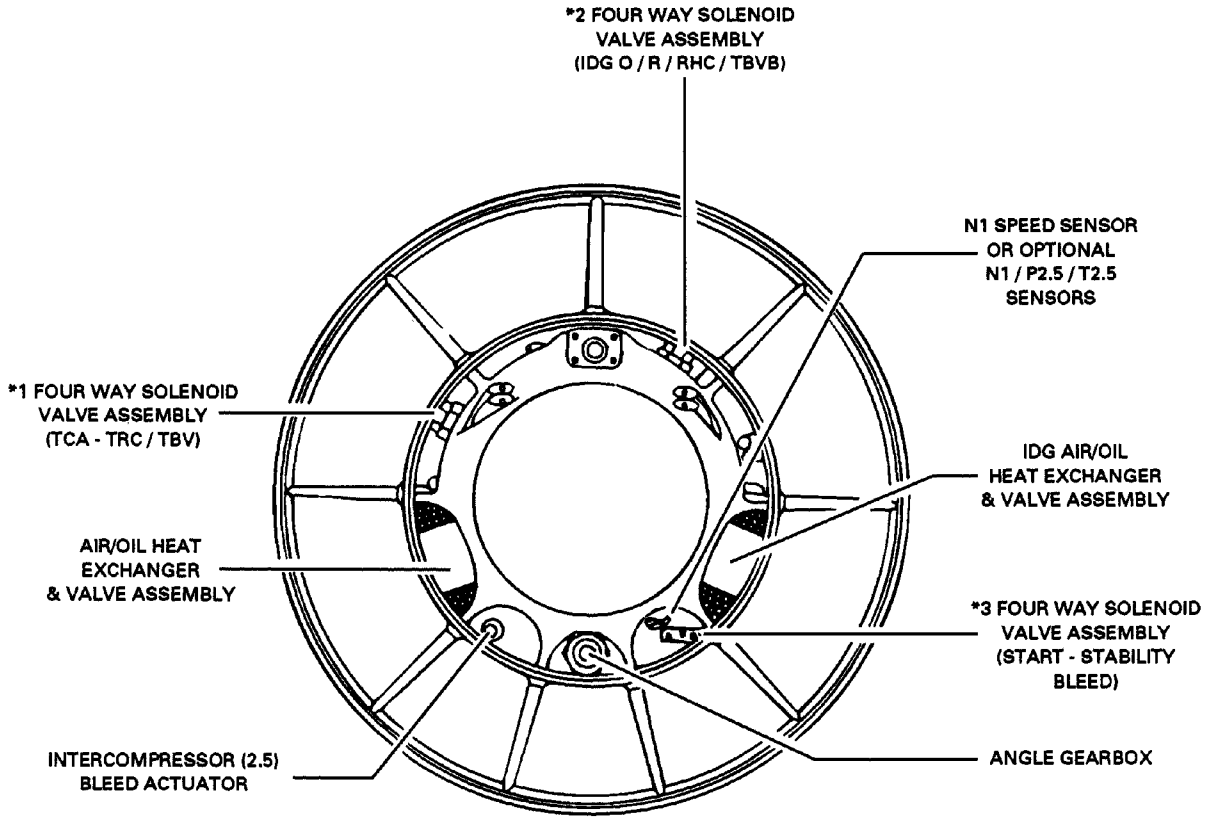
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	FULL AUTHORITY DIGITAL		435	435AL	73-21-01
	ENGINE CONTROL UNIT (FADEC)		445	445AL	
	ALTERNATOR-PERMANENT		452	452AR	73-24-01
	MAGNET		462	462AR	
	PLUG-FADEC DATA ENTRY		435	435AL	73-24-02
			445	445AL	


P2 / T2 INLET PROBE
(ON NACELLE)
TURBINE (BLADE AND VANE) COOLING AIR (TCA) VALVE
COMPRESSOR STABILITY BLEED
PUSH - PULL CABLE
TURBINE CASE COOLING (TCC) ACTUATOR
HPT / TCC VALVE
EGT PROBES
EGT BOX & CABLE
TRC / TBV VALVE
P2. 5 / T2. 5 MINIMUX
IGNITER LEADS
LPT / TCC VALVE
FUEL DISTRIBUTION VALVE
FUEL T / C
OIL PUMP
FUEL PUMP / EXCITER FUEL METERING UNIT (2)
NO. 3 BEARING SCAVENGE OIL T / C
ΔP SWITCH
STATOR VANE ACTUATOR
L-A1096
BM5 73 24 00 0 KRMO - 20

Component Location - Right Side
Figure 010



Component Location - Left Side
Figure 011


*2 FOUR WAY SOLENOID VALVE ASSEMBLY (IDG O / R / RHC / TBVB)
N1 SPEED SENSOR OR OPTIONAL N1 / P2.5 / T2.5 SENSORS
*1 FOUR WAY SOLENOID VALVE ASSEMBLY (TCA - TRC / TBV)
IDG AIR/OIL HEAT EXCHANGER & VALVE ASSEMBLY
AIR/OIL HEAT EXCHANGER & VALVE ASSEMBLY
*3 FOUR WAY SOLENOID VALVE ASSEMBLY (START - STABILITY BLEED)
INTERCOMPRESSOR (2.5) BLEED ACTUATOR
ANGLE GEARBOX

BM5 73 24 00 0 KVMO - 00

Component Location on Intermediate Case
Figure 012

PERMANENT MAGNET ALTERNATOR - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B. Material No.P03-001	Oils (Ref. 70-00-00)
C. Material No.P06-002	Lubricants (Ref. 70-00-00)
D. Material No.P06-021	Lubricants (Ref. 70-00-00)
E. PWA85238	Wrench (Optional to PWA86603)
F. PWA86603	Adapter
G. PWA85749	Torque Adapter
H. PWA86551	Puller
I.	Packing
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 80-13-01, P. Block 401	Pneumatic Starter Assembly
- 80-13-10, P. Block 401	Pneumatic Starter Heatshield Assembly

2. Alternator Stator

A. Procedure

(1) Job Set-Up

(a) Open, safety and tag the appropriate circuit breakers and open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

(b) Remove pneumatic starter assembly (Ref. 80-13-01, P. Block 401).

(c) Remove starter heatshield (Ref. 80-13-10, P. Block 401).

(2) Removal (Ref. Fig. 401, 402)

(a) Using PWA85749 torque adapter disconnect W3P1 and W5P6 harness connectors from alternator stator cables at bracket on lower left side of gearbox.

(b) Remove two bolts securing stator cable connectors, retaining plate, to bracket. Remove retaining plate.

(c) Remove both cable connectors from bracket.

(d) Remove cables from spring clips at brackets on rear face of gearbox.

(e) Disconnect cooling air hose at alternator stator by loosening clamp at stator. Pull hose from fitting.

(f) Remove three bolts and washer if equipped securing alternator stator.

PRE SB PW4ENG 75-59

Remove heat shield to gearbox.

END PRE SB PW4ENG 75-59.

(g) Remove stator and heat shield if equipped from gearbox.

(h) Discard packing.

(i) Install protective closures.

(3) Installation (Ref. Fig. 401, 402)

(a) Remove protective closures.

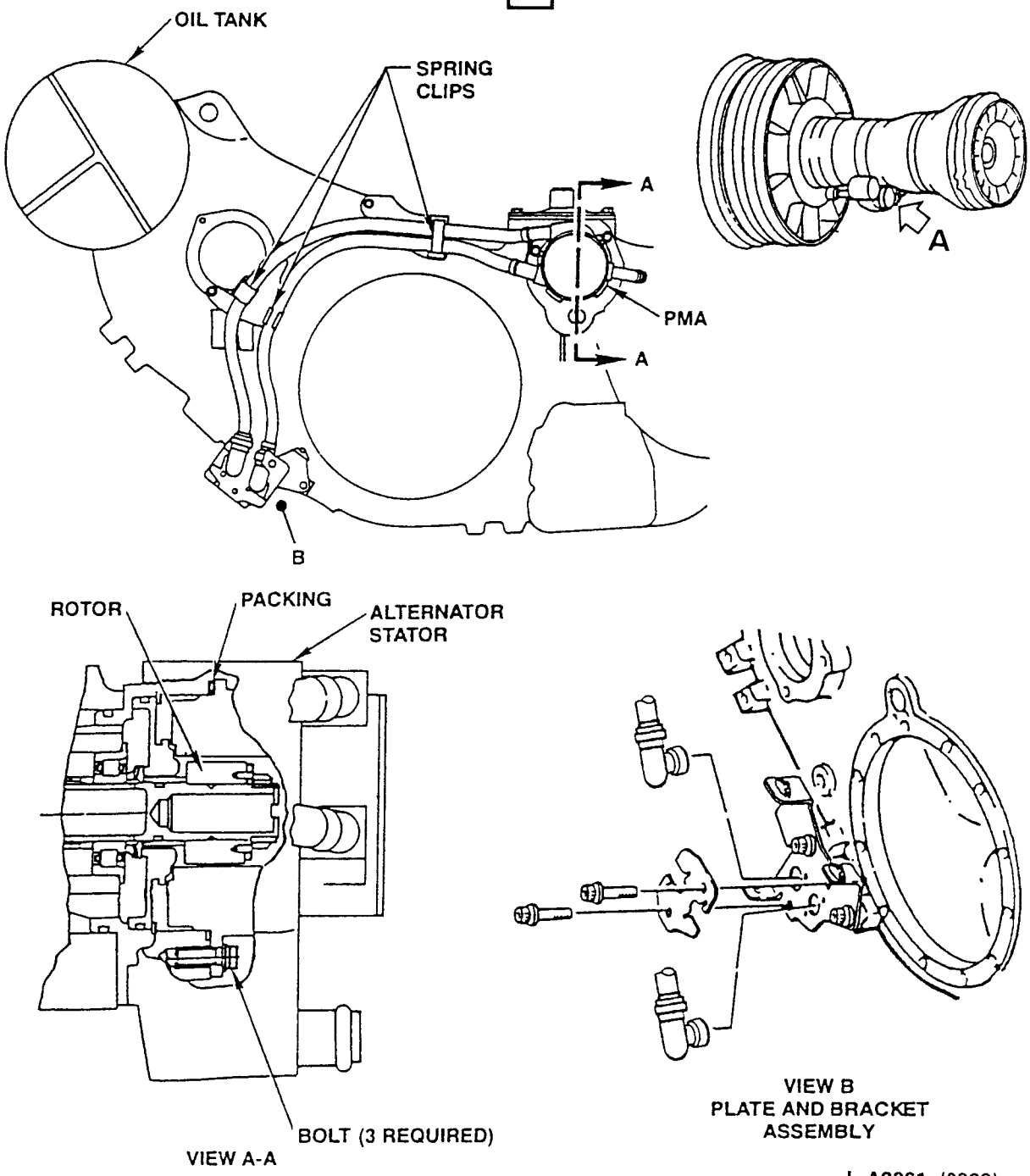
(b) Lubricate new packing with Material No.P06-002, and install on alternator stator.

(c)Align boltholes in stator with boltholes on gearbox, and carefully install stator over rotor.
(d)Secure stator and heat shield if equipped to gearbox with three bolts, threads lubricated with Material No.P06-021, and washer if equipped, at location shown.
NOTE : POST SB PW4ENG 75-59 engines do not require a heatshield or washer under the bolt head.
(e)TORQUE bolts to between 62 and 72 lbf.in. (0.70 and 0.81 m.daN).
(f)Connect cooling air hose to fitting on starter. Secure with clamp. TORQUE clamp to between 25 and 30 lbf. in. (0.28 and 0.34 m.daN).
(g)Install cable connectors to bracket on lower left side of gearbox.
1 With plate spacers facing bracket, install retaining plate over connector flanges. Secure retaining plate to bracket with two bolts.
2 Lubricate threads of inboard bolt with Material No.P06-021. TORQUE bolt to between 62 and 72 lbf.in. (0.70 and 0.81 m.daN).
3 Lubricate threads of outboard bolt with Material No.P03-001. TORQUE bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(h)Secure cables to spring clips on bracket on deoiler outlet flange, and on bracket on gearbox above IDG drive pad.
(i)Connect W3P1 harness connector to respective stator cable connector.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.
(j)Connect W5P6 harness connector to respective stator cable connector.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(4)Close-Up
(a)Install starter heatshield (Ref. 80-13-10, P. Block 401).
(b)Install pneumatic starter assembly (Ref. 80-13-01, P. Block 401).
(c)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(d)Close thrust reverser and fan cowl doors. Remove safety clips and tag and close circuit breakers (Ref. 71-13-00, P. Block 301).
(e)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

3. Alternator Rotor

A. Procedure
(1)Job Set-Up
(a)Open, safety and tag the appropriate circuit breakers and open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(b)Remove alternator stator (Ref. Para. 2.).
(2)Removal (Post SB PW4ENG 72-375)
(a)Loosen the rotor retaining nut with PWA86603 Adapter as follows



Permanent Magnet Alternator (FADEC Alternator Stator)
Figure 401

(Ref. Fig. 404).

1 Loosen both jamnuts (3). While you hold the body (2), loosen the wrench detail (4).

2 Install the handle (6), lug end facing outward, over the mating lug of wrench detail (4).

3 Align bolt holes and position body (2) over EEC gearshaft (8) and onto the gearshaft housing (1) pad.

4 Engage lugs of wrench detail with mating slots in gearshaft. Attach the body (2) with three detail screws (5).

5 Seat the wrench detail (4) firmly on the gearshaft and tighten the jamnuts (3).

6 Engage the lugs of handle (6) with the mating lugs in the nut (7). Turn the handle to loosen the nut using a standard 1/2 inch drive.

NOTE : This must be done in several steps as the handle movement is limited. The handle must be removed and positioned again to the nut.

7 Remove the screws (5) that attach the Adapter to the gearbox and remove Adapter.

(b)Remove the nut (7) that attaches EEC alternator rotor to the gearshaft.

(c)Remove the rotor (5) from the gearshaft (6) with a PWA86551 Puller as follows (Ref. Fig. 405).

1 Retract the hex bolt (2) on the rotor puller. Loosen the two socket head screws (3) and install the jaws (1) in the puller groove on the rotor (5).

2 Install the ring (4) around the jaws (1) and against the shoulder of the jaws.

3 Tighten the two socket heads screws (3).

4 Tighten the hex head bolt (2) until the rotor is removed from the gearshaft (6).

NOTE : The puller and rotor can turn when the hex bolt (2) is tightened. To prevent the rotor from turning, you can install a rod or punch into one of the holes in the puller jaws and hold while the hex bolt is tightened.

5 Loosen the hex bolt (2) and the two socket head screws (3). Remove the ring (4) from the puller and remove the puller from the rotor.

(d)Install protective covers.

(3)Installation (Post SB PW4ENG 72-375) (Ref. Fig. 404).

(a)Remove protective covers.

CAUTION : MAKE SURE THE ROTOR IS FULLY AGAINST (SEATED) THE GEARSHAFT. DO NOT USE INDUCTION HEATING TO ASSEMBLE THE PMA ROTOR ASSEMBLY. INDUCTION HEATING CAN DAMAGE THE MAGNETIC MATERIAL IN THE ROTOR.

(b)Install the EEC alternator rotor (9) on gearshaft (8).

CAUTION : WHEN USING THE FOLLOWING ADAPTER THE ACTUAL TORQUE WRENCH READING WILL BE LESS THAN THAT STATED BELOW. SEE STANDARD TORQUES, STANDARD PRACTICES SECTION.

(c)Lubricate the nut with Material No.P03-001, and install the nut to gearshaft. Torque the nut using PWA86603 Adapter as follows.

1 Loosen both jamnuts (3). While you hold the body (2), loosen the wrench detail (4).

2 Install the handle (6), lug end facing outward, over the mating lug

of wrench detail (4).

3 ALign bolt holes and position body (2) over EEC gearshaft (8) and onto the gearshaft housing (1) pad.

4 Engage lugs of wrench detail with mating slots in gearshaft. Attach the body (2) with three detail screws (5).

5 Seat the wrench detail (4) firmly on the gearshaft and tighten the jamnuts (3).

6 Engage the lugs of handle (6) with the mating lugs in the nut (7).

7 Using a standard 1/2 inch drive, TORQUE the nut to between 675 and 800 lbf.in. (7.63 and 9.03 m.daN) loosen to 0 TORQUE, then TORQUE again to between 675 and 800 lbf.in. (7.63 and 9.03 m.daN).

NOTE : This must be done in several steps because the handle movement is limited. The handle must be removed and repositioned to nut.

8 Remove the screws (5) that attach the Adapter to gearbox and remove adapter.

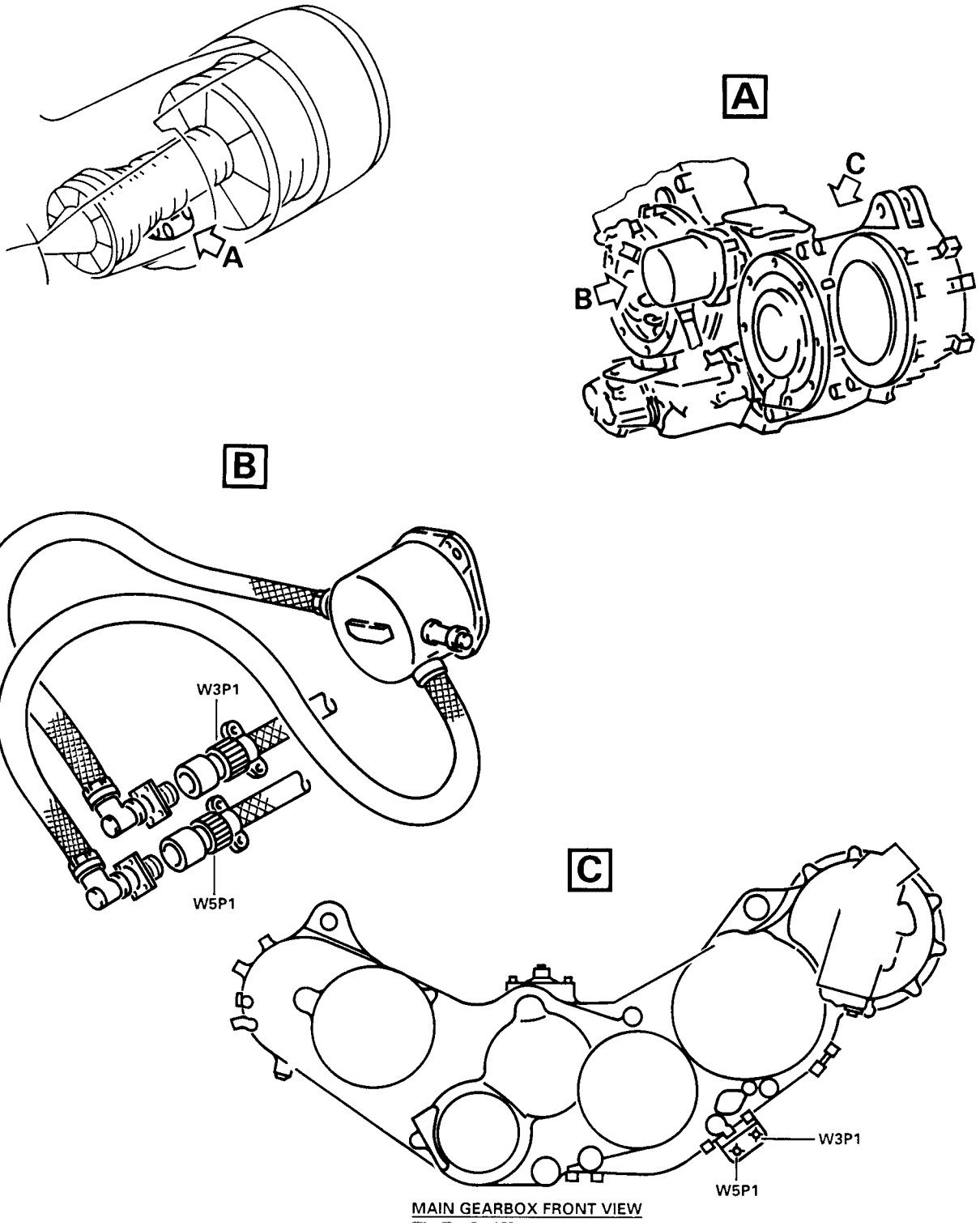
(4)CLose-up

(a)Install alternator stator (Ref. Para. 2.).

(b)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

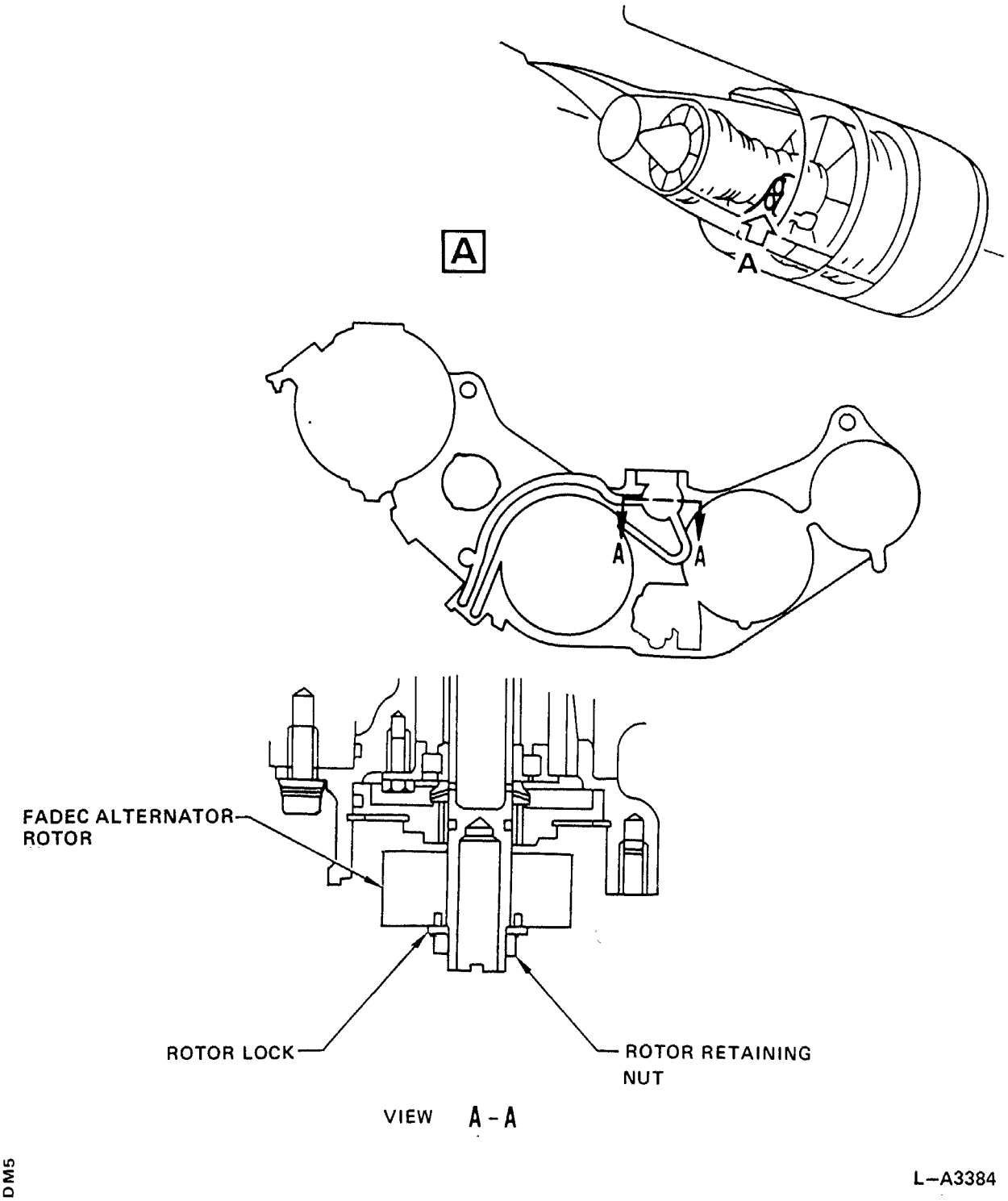
(c)Close thrust reverser and fan cowl doors. Remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

(d)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

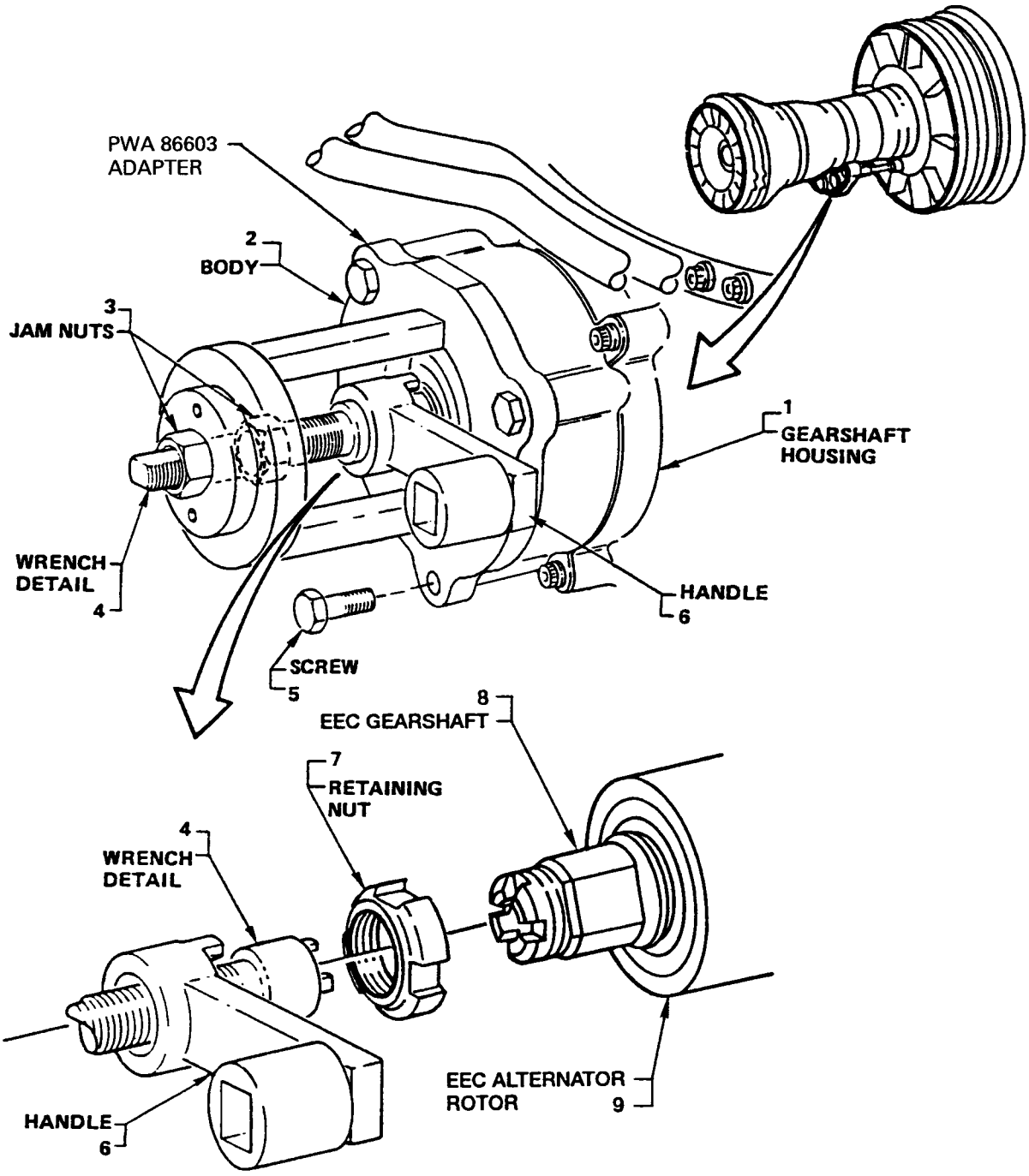


MAIN GEARBOX FRONT VIEW

Connector Location
Figure 402



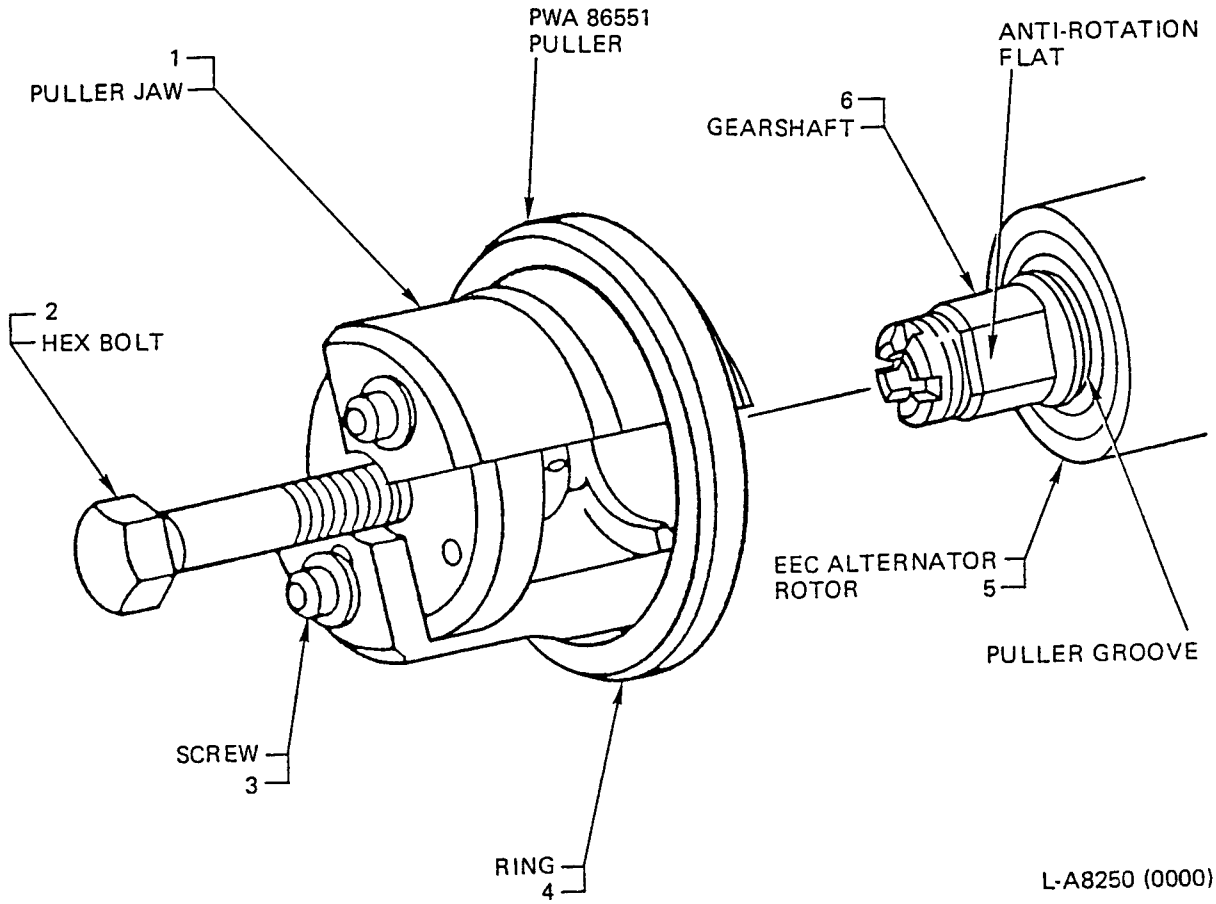
Permanent Magnet Alternator (FADEC Alternator Rotor)
Figure 403



BM5 73 24 01 4 KEN0 01

L-A8249 (0194)

Installation of The Rotor Retaining Nut
Figure 404



BM5 73 24 01 4 KGNO - 00

Installation of PWA86551 Puller to Alternator Rotor
Figure 405

FADEC PROGRAMMING PLUG - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Access Platform
C.	Protective Closures
D.	Torque Wrench
E.	Pin, Rivet (New Configuration Only)
F.	Collar (New Configuration Only)
G. Material No.P03-001	Oils (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant - General
- 71-00-10, P. Block 201	Engine Component Intermix

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
For engine 1			
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
For engine 2			
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(2)Install access platform

(3)Open left fan cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Basic Configuration) (Ref. Fig. 401)

(1)Remove the bolt, nut and washers that attach the lanyard to inlet case Flange A1.

(2)Loosen and remove the FADEC programming plug from FADEC.

(3)Install the protective closures to the FADEC connector and the programming plug.

C. Removal (New Configuration) (Ref. Fig. 402)

(1)Remove the rivet pin and collar that attach the lanyard to the upper forward mount bracket of the FADEC.

(2)Loosen and remove the FADEC programming plug from the FADEC.

(3)Install protection covers to the FADEC connector and the programming plug.

D. Installation (Basic Configuration) (Ref. Fig. 401)

CAUTION : CLASS OF THE FADEC PROGRAMMING PLUG HAS TO COMPLY WITH THE ENGINE/AIRCRAFT CONFIGURATION (REF. 71-00-10, P. BLOCK 201).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE PROGRAMMING PLUG INSTALLATION (REF. 70-00-00, P. BLOCK 201, SAME AS THE HARNESS CONNECTOR INSTALLATION PROCEDURE). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE PLUG CAN OCCUR. A LOOSE PLUG CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(1)Remove protection covers protective closures. Install the programming plug to the connector on the FADEC (Ref. 70-00-00, P. Block 201).

(2)Attach the lanyard to the inlet case Flange A1 with the bolt, threads lubricated with Engine Oil, Material No.P03-001, washers (under bolthead and nut) and nut. TORQUE the nut to between 36 and 40 lbf. in. (0.41 and 0.45 m. daN).

E. Installation (New Configuration) (Ref. Fig. 402)

CAUTION : CLASS OF THE FADEC PROGRAMMING PLUG HAS TO COMPLY WITH THE ENGINE/AIRCRAFT CONFIGURATION (REF. 71-00-10, P. BLOCK 201).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. Block 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(1)Remove the protection covers. Install the FADEC programming plug to the receptacle on the FADEC (Ref. 70-00-00, P. Block 201). (Same as connector installation procedure).

(2)Attach the lanyard to the upper forward mount bracket of the FADEC with a rivet pin and collar.

D. Close-Up and Test

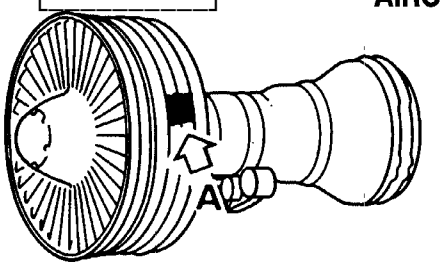
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close fan cowl doors (Ref. 71-13-00, P. Block 301).

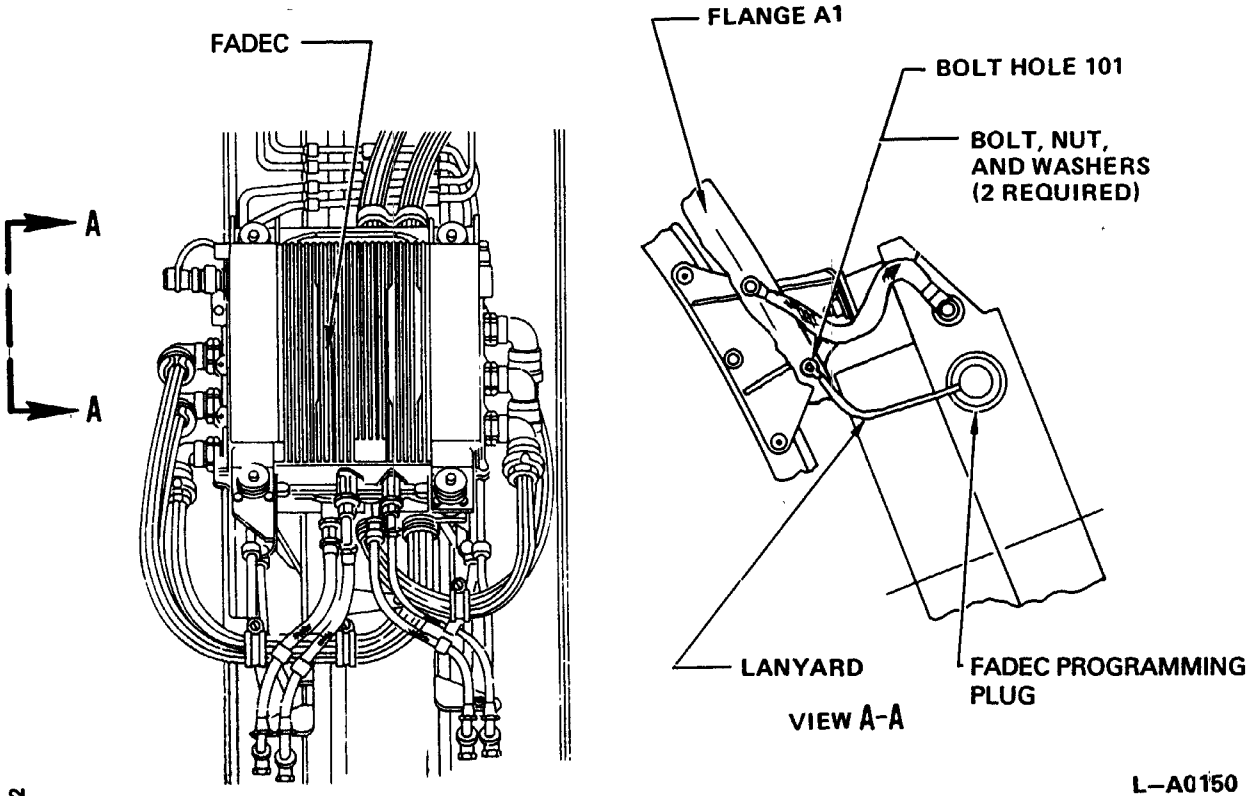
(3)Remove access platform.

(4)Remove safety clips and tags and close circuit breakers 35KS, 37KS, 34KS 36KS.

(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

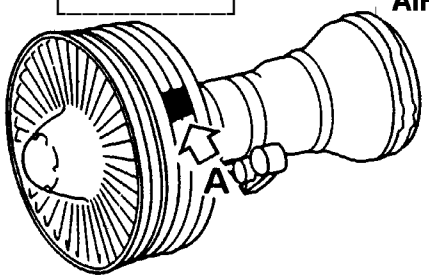


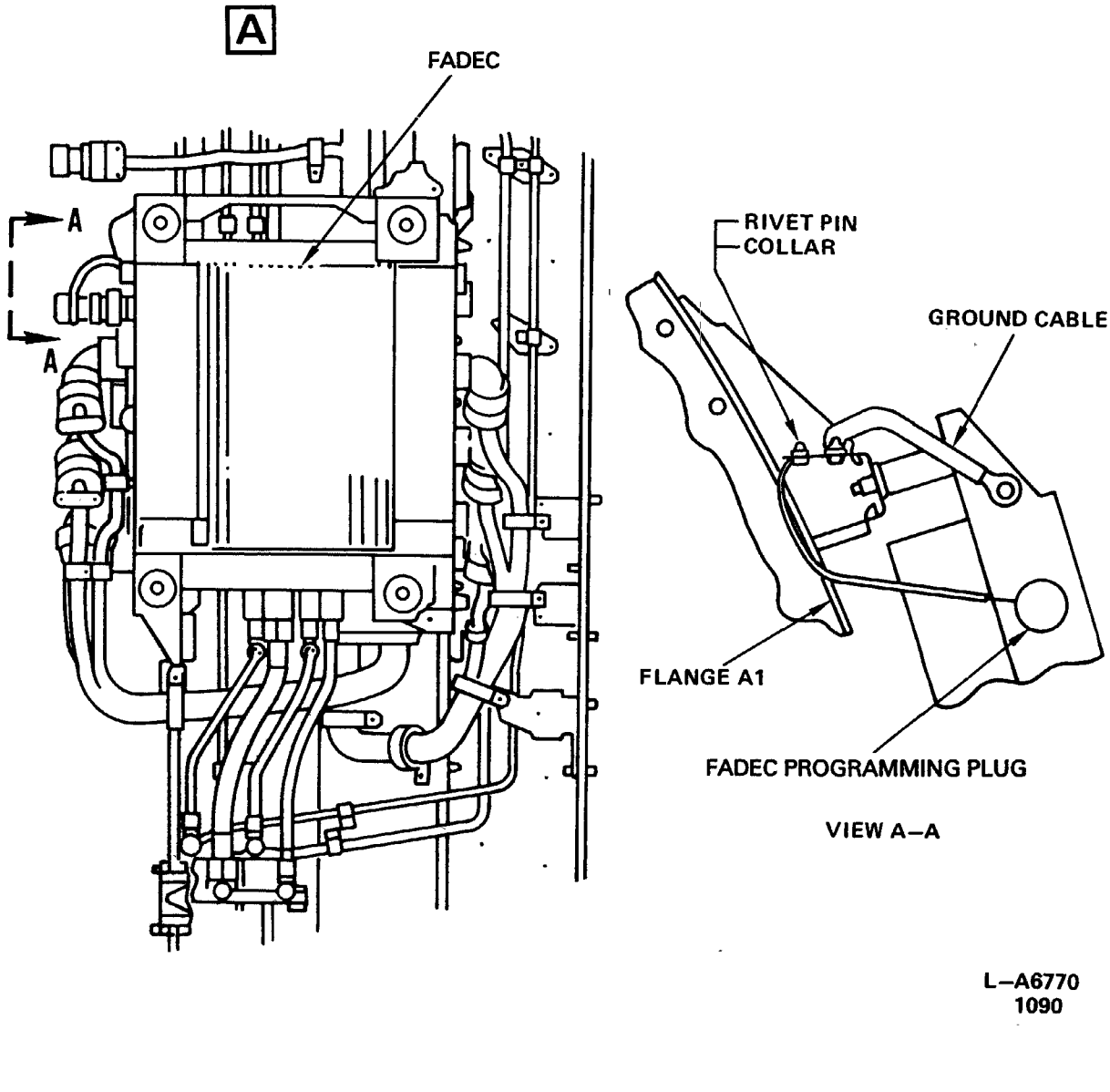
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BM5 73 24 02 4 KAMO - 02

FADEC Programming Plug (Basic Configuration)
Figure 401





FADEC Programming Plug (New Configuration)
Figure 402

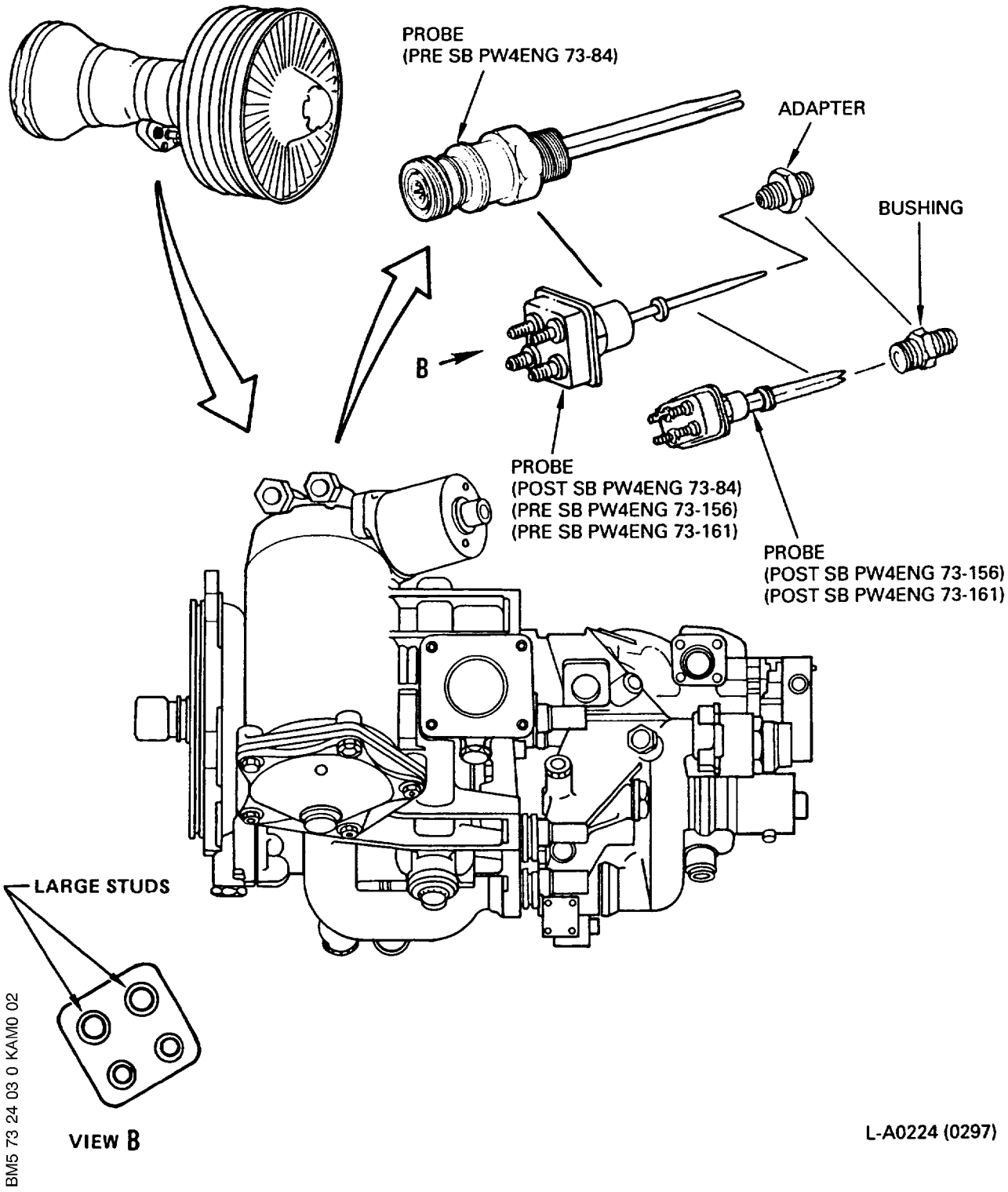
FADEC FUEL TEMPERATURE THERMOCOUPLE PROBE - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

A. The fuel temperature probe provides the FADEC with a thermocouple signal to permit control of fluid temperature.

B. The probe consists of two chromel/alumel thermocouples which provide independent temperature signals to each channel of the FADEC.

C. The fuel temperature probe is located in the fuel pump interstage passage to sense fuel temperature due to heat input from the fuel/oil heat exchanger and/or fuel metering unit by pass flow.



FADEC Fuel Temperature Thermocouple Probe
Figure 001

FADEC FUEL TEMPERATURE THERMOCOUPLE PROBE - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
C.	TORQUE Wrench
D.	Container Minimum Capacity of 5 U.S. Gallons (19 Liters)
E.	Packing
F.	Protective Closure
G. Material No.P03-001	Oils (Ref. 70-00-00)
H. Material No.P05-289	Special Materials (Ref. 70-00-00)
I. Material No.P05-291	Special Materials (Ref. 70-00-00)
J. Material No.P05-292	Special Materials (Ref. 70-00-00)
K. Material No.P06-002	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant-General

2. Procedure

A. Job Set-Up

(1)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(2)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
133VU	ENGINES/ENG2/REVERSE/CTL	2KM	331/V74
133VU	ENGINES/ENG1/REVERSE/CTL	1KM	332/U69
133VU	ENGINES/ENG2/IGNITION/SYS A	8JH	333/T71
133VU	ENGINES/ENG1 & 2/IGNITION/SYS B	2JH	333/T72
133VU	ENGINES/ENG1/IGNITION/SYS A	1JH	334/S72
133VU	ENGINES/ENG1 & 2/START/CTL & WARN	1KG	335/R68
132VU	ANTI-ICE/PROBES/CAPT/L STAT	4DA	322/N68
132VU	ANTI-ICE/PROBES/F/O/L STAT	8DA	323/M66

(3)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal

(1)(Pre SB PW4ENG 73-84), remove the harness connector and the probe as follows (Ref. Fig. 401).

(a)Disconnect W5P8 harness connector from FADEC fuel temperature thermocouple probe located on upper end of fuel pump filter housing.

(b)Remove lockwire from probe and remove probe from boss on fuel pump

filter housing. Discard packing.
NOTE : Be prepared to catch fuel in a container with a minimum capacity of 5 U.S. gallons (19 liters).
(c)Install protective closure.
(2)(Post SB PW4ENG 73-84) (Pre SB PW4ENG 73-156 and Pre SB PW4ENG 73-161)
Remove the harness connector and the thermocouple probe as follows (Ref. Fig. 402) (sheets 1/3 and 2/3):
(a)Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.
(b)Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.
(c)Remove the wiring harness terminals from the thermocouple studs.
(d)Remove the lockwire or safety cable from the thermocouple probe nut to the adapter. Remove the thermocouple probe from the housing.
NOTE : Be prepared to catch fuel in a container with a minimum capacity of 5 U.S. gallons (19 liters).
(e)Remove the lockwire or safety cable from the adapter to the housing. Remove the adapter from the housing and discard the packing.
(f)Install protection covers.
(3)(Post SB PW4ENG 73-156 and Post SB PW4ENG 73-161)
Remove the harness connector and the thermocouple probe as follows: (Ref. Fig. 402) (sheets 1/3 and 3/3):
(a)Remove the nuts that attach the W5 wiring harness to the studs on the thermocouple.
(b)Remove the bolt, clamp, and ground strap that are attached to the bracket on the fuel pump filter housing.
(c)Remove the wiring harness terminals from the thermocouple studs.
(d)Remove two bolts (8) that attach the thermocouple probe (1) to the bracket assembly (3) and (5) and remove the thermocouple probe (1) from the housing.
NOTE : Be prepared to catch fuel in a container with a minimum capacity of 5 U.S. gallons (19 liters).
(e)If applicable, remove the bracket assembly (3) and (5), plug (9), bolt (7), bushing (6) and packings (4) and (10). Discard the packings.
(f)Install protection covers.

C. Installation
(1)Remove protective closure.
(2)For thermocouple probe with a keyway type receptacle (Pre SB PW4ENG 73-84). Install probe as follows (Ref. Fig. 401):
(a)Install packing lubricated with Material No.P06-002, to FADEC fuel temperature thermocouple probe.
(b)Lubricate threads of probe with Material No.P03-001 and install probe to boss on upper end of fuel pump filter housing. TORQUE probe to between 110 and 120 lbf.in. (1.24 and 1.35 m.daN). Install Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to the probe.
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRA-

TION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(c)Connect W5P8 harness connector to probe.

(3)For a thermocouple probe with a studed terminal type receptacle (Post SB PW4ENG 73-84, Pre SB PW4ENG 73-156 and Pre SB PW4ENG 73-161). Install probe as follows (Ref. Fig. 402) (sheets 1/3 and 2/3):

(a)Install a packing, lubricated with Material No.P06-002, to the adapter of the fuel temperature thermocouple probe.

(b)(Reference 2166) remove protection covers and install the concave end of the adapter into the port of the housing. TORQUE the adapter to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Install Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) from the adapter to the housing.

(c)Lubricate the threads of the thermocouple probe with Material No.P03-001, and install the probe into the adapter in the fuel pump filter housing.

(d)Turn the thermocouple probe to align the thermocouple studs with the terminal on the wiring harness.

NOTE : Do not install the clamp, ground strap, and bolt to the bracket on the housing at this time.

(e)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.

(f)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(g)(Reference 2167), hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.

(h)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(4)(Post SB PW4ENG 73-156 and Post SB PW4ENG 73-161) Install the FADEC fuel temperature thermocouple probe and wiring harness connector as follows: (Ref. Fig. 402) (Sheets 1/3 and 3/3).

(a)Install a packing (10) lubricated with Petrolatum White (Material No.P06-002) onto the plug (9) and install the plug (9) into the aft port in the main fuel pump housing.

(b)TORQUE the plug to between 110 and 120 lbf.in. (1.25 and 1.35 m.daN).

(c)Install new packing (10) onto the bushing (6) and position bushing (6) into the forward port in the main fuel pump housing.

(d)TORQUE the bushing (6) to between 110 and 120 lbf.in. (1.25 and 1.35 m.daN).

(e)Attach the bracket (5) to the plug (9) with a bolt (7) and TORQUE the bolt lubricated with Engine Oil (Material No.P03-001) to between 85

and 95 lbf.in. (0.97 and 1.07 m.daN).

(f)Align contour and bolt holes of the two brackets (3) and (5) and attach them together with two countersunk screws (2). TORQUE the screws to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(g)Install a new packing (4) lubricated with Engine Oil (Material No.P03-001) on the FADEC fuel temperature thermocouple probe (1) and install the thermocouple probe (1) into the bracket assembly (3) and (5).

(h)Rotate the thermocouple probe (1) so that the smaller diameter terminal studs are closest to the harness and seat the probe flange against the bracket assembly.

(i)Attach the thermocouple probe (1) to the bracket assembly with two bolts (8) and TORQUE the bolts lubricated with Engine Oil (Material No.P03-001) to between 85 and 95 lbf.in. (0.97 and 1.07 m.daN).

CAUTION : DO NOT LUBRICATE THE THREADS ON THE THERMOCOUPLE WIRING HARNESS CONNECTIONS (TERMINAL STUDS). LUBRICATION OF THE THREADS COULD CAUSE MALFUNCTION OF THE THERMOCOUPLE.

(j)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.

(k)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(End SB PW4ENG 73-156 and SB PW4ENG 73-161)

(5)(Reference 2163) TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).

(6)(Reference 2164) TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(7)(Pre SB PW4ENG 73-156 and Pre SB PW4ENG 73-161) Install Lockwire (Material No.P05-289) or Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) from the coupling nut to the adapter.

(End Pre SB PW4ENG 73-156 and Pre SB PW4ENG 73-161)

(8)TORQUE the bolt that attachs the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

D. Close-Up and Test

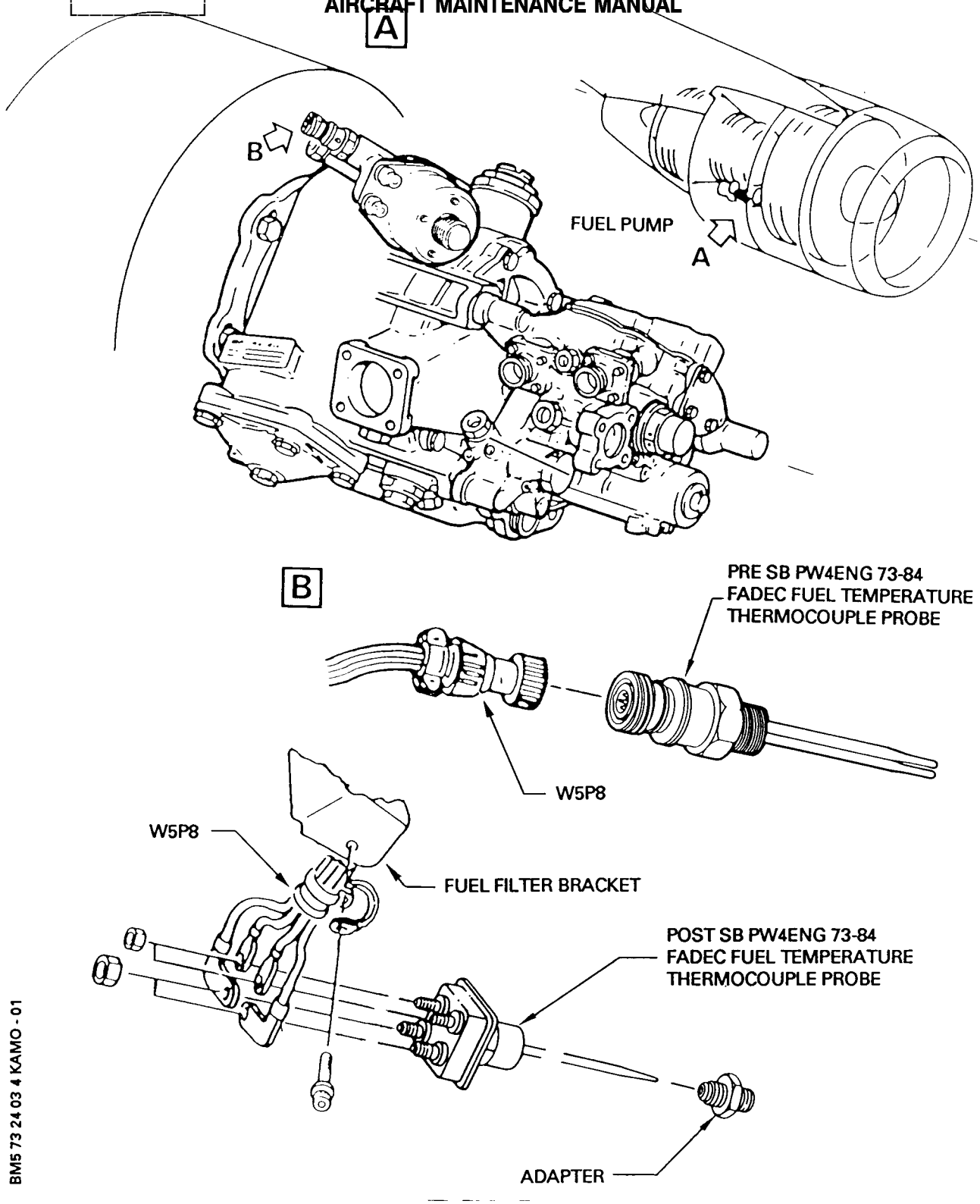
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

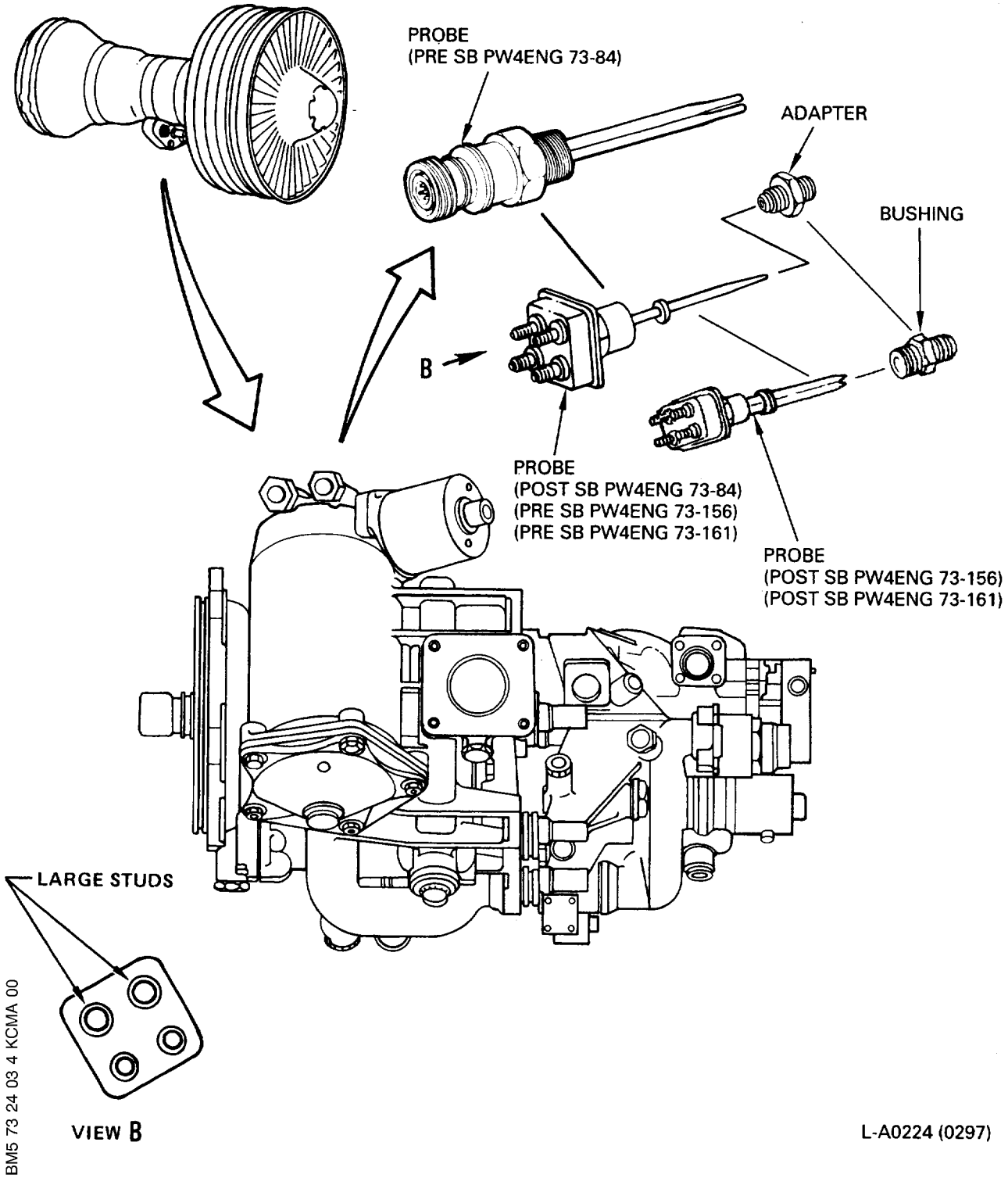
(3)On the appropriate FIRE control module, push the fire handle and remove the warning notice.

(4)Remove safety clips and tags and close circuit breakers 1JH, 2JH, 8JH, 1KG, 1KM, 2KM, 4DA and 8DA.

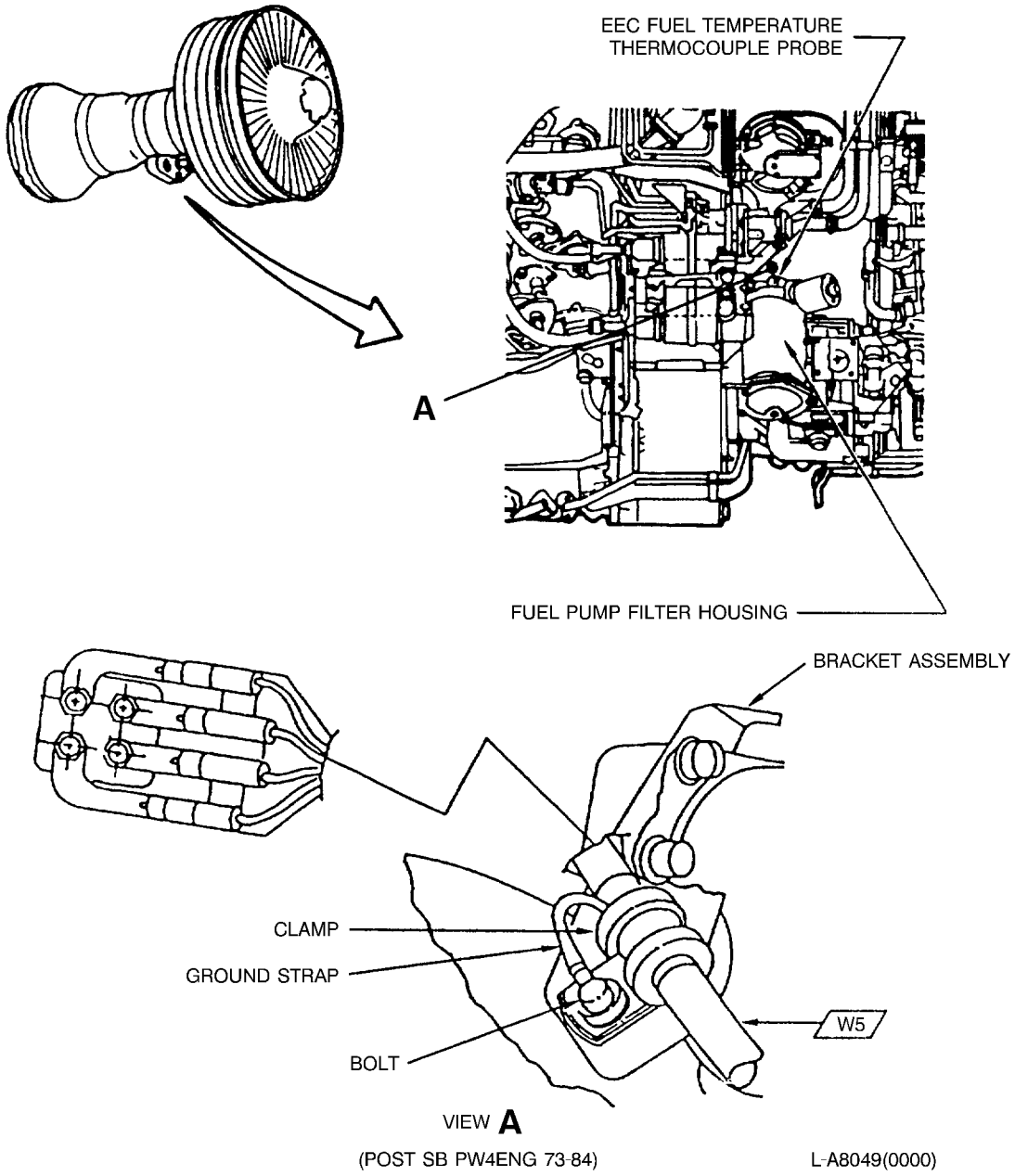
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



FADEC Fuel Temperature Thermocouple Probe
Figure 401

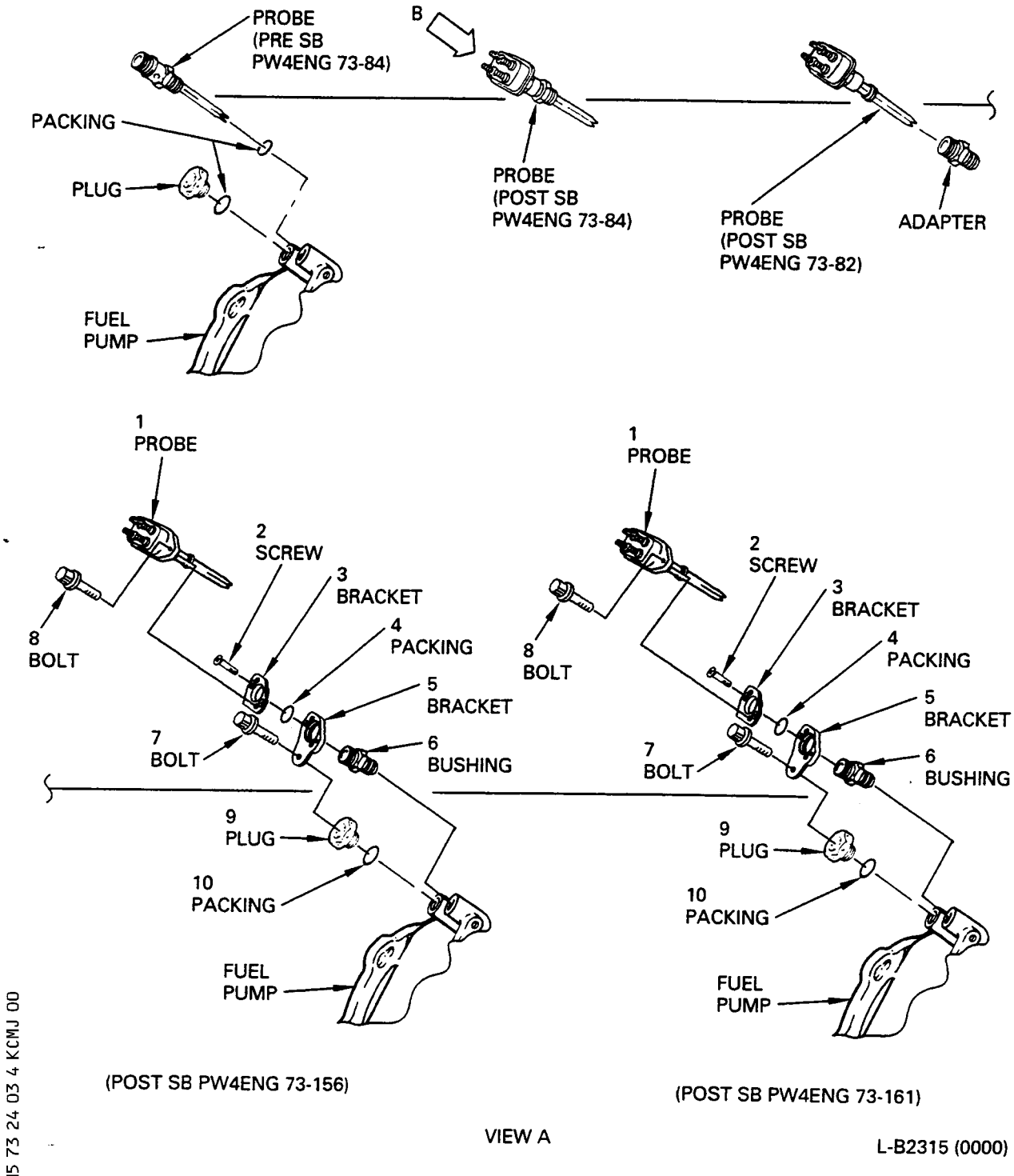


FADEC Fuel Temperature Thermocouple Probe (Sheet 1/3)
Figure 402



BM5 73 24 03 4 KCMB 01

FADEC Fuel Temperature Thermocouple Probe (Sheet 2/3)
Figure 402



BM5 73 24 03 4 KCMJ 00

FADEC Fuel Temperature Thermocouple Probe (Sheet 3/3)
Figure 402

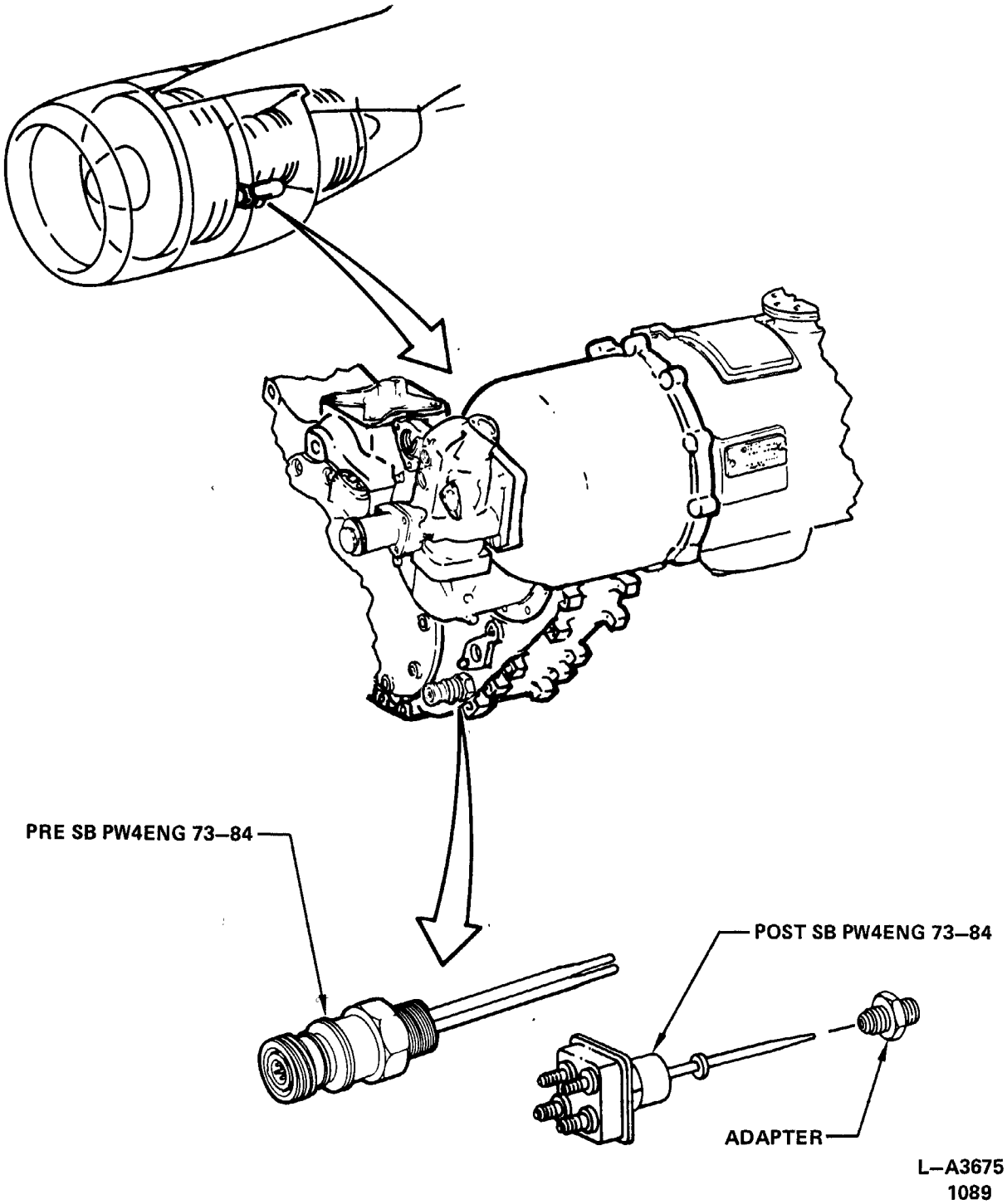
FADEC OIL TEMPERATURE THERMOCOUPLE PROBE - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

A. The oil temperature probe provides the FADEC with a thermocouple signal to permit control of fluid temperature.

B. The probe consists of two chromel/alumel thermocouples which provide independent temperature signals to each channel of the FADEC.

C. The oil temperature probe is located in the gearbox oil scavenge passage and senses engine oil temperature returning from various engine lubrication areas.



FADEC Oil Temperature Thermocouple Probe
Figure 001

FADEC OIL TEMPERATURE THERMOCOUPLE PROBE - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
C.	Container Minimum Capacity of 5 U.S. Gallons (19 Liters)
D.	Packing
E.	Protective Closure
F.	Warning Notice
G. Material No.P03-001	Oils (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant-General

2. Procedure

NOTE : Do not mistake the FADEC Oil Temperature Thermocouple Probe located on the gearbox at connector P18, for the Oil Temperature Sensor located at DT582 connector (Ref. 79-32-11, P. Block 401).

A. Job Set-Up

(1)On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(2)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
133VU	ENGINES/ENG2/REVERSE/CTL	2KM	331/V74
133VU	ENGINES/ENG1/REVERSE/CTL	1KM	332/U69
133VU	ENGINES/ENG2/IGNITION/SYS A	8JH	333/T71
133VU	ENGINES/ENG1 & 2/IGNITION/SYS B	2JH	333/T72
133VU	ENGINES/ENG1/IGNITION/SYS A	1JH	334/S72
133VU	ENGINES/ENG1 & 2/START/CTL & WARN	1KG	335/R68
132VU	ANTI-ICE/PROBES/CAPT/L STAT	4DA	322/N68
132VU	ANTI-ICE/PROBES/F/O/L STAT	8DA	323/M66

(3)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal

(1)(Pre SB PW4ENG 73-84) Remove the harness connector and the probe as follows (Ref. Fig. 401).

(a)Disconnect W3P18 harness connector from FADEC oil temperature thermocouple probe located on lower, left side of main gearbox front face.

(b)Remove lockwire from probe and remove probe from boss on gearbox. Discard packing.

NOTE : Be prepared to catch oil in a container with a minimum capacity of 5 U.S. gallons (19 liters).

(c)Install protective closure.

(2)(Post SB PW4ENG 73-84), Remove the harness connector and the thermocouple probe follows (Ref. Fig. 402).

(a)Remove the nuts that attach the W3 wiring harness to the studs on the thermocouple.

(b)Remove the bolt, clamp, and ground strap that are attached to the main gearbox pressure tube (LP12).

(c)Remove the wiring harness terminals from the thermocouple studs.

(d)Remove the lockwire from the thermocouple probe nut to the adapter. Remove the thermocouple probe from the housing.

NOTE : Be prepared to catch oil in a container with a minimum capacity of 5 U.S. gallons (19 liters).

(e)Remove the lockwire from the adapter to the housing. Remove the adapter from the housing and discard packing.

(f)Install protection covers.

C. Installation (Ref. Fig. 401, 402)

(1)Remove protective closure.

(2)For a thermocouple probe with a keyway type receptacle (Pre SB PW4ENG 73-84) :

(a)Install packing lubricated with Material No.P03-001 to FADEC oil temperature thermocouple probe.

(b)Lubricate threads of probe with Material No.P03-001 and install probe to boss located on lower, left side of main gearbox front face. TORQUE probe to between 110 and 120 lbf.in. (1.24 and 1.35 m.daN). Wirelock probe.

(c)Connect W3P18 harness connector to probe.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(3)For a thermocouple probe with a studed terminal type receptacle (Post SB PW4ENG 73-84) :

(a)Install a packing, lubricated with Material No.P06-002, to the adapter of the FADEC oil temperature thermocouple probe.

(b)(Reference 571) remove protection covers and install the concave end of the adapter into the port of the gearbox housing. TORQUE the adapter to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Install lockwire from the adapter to the housing.

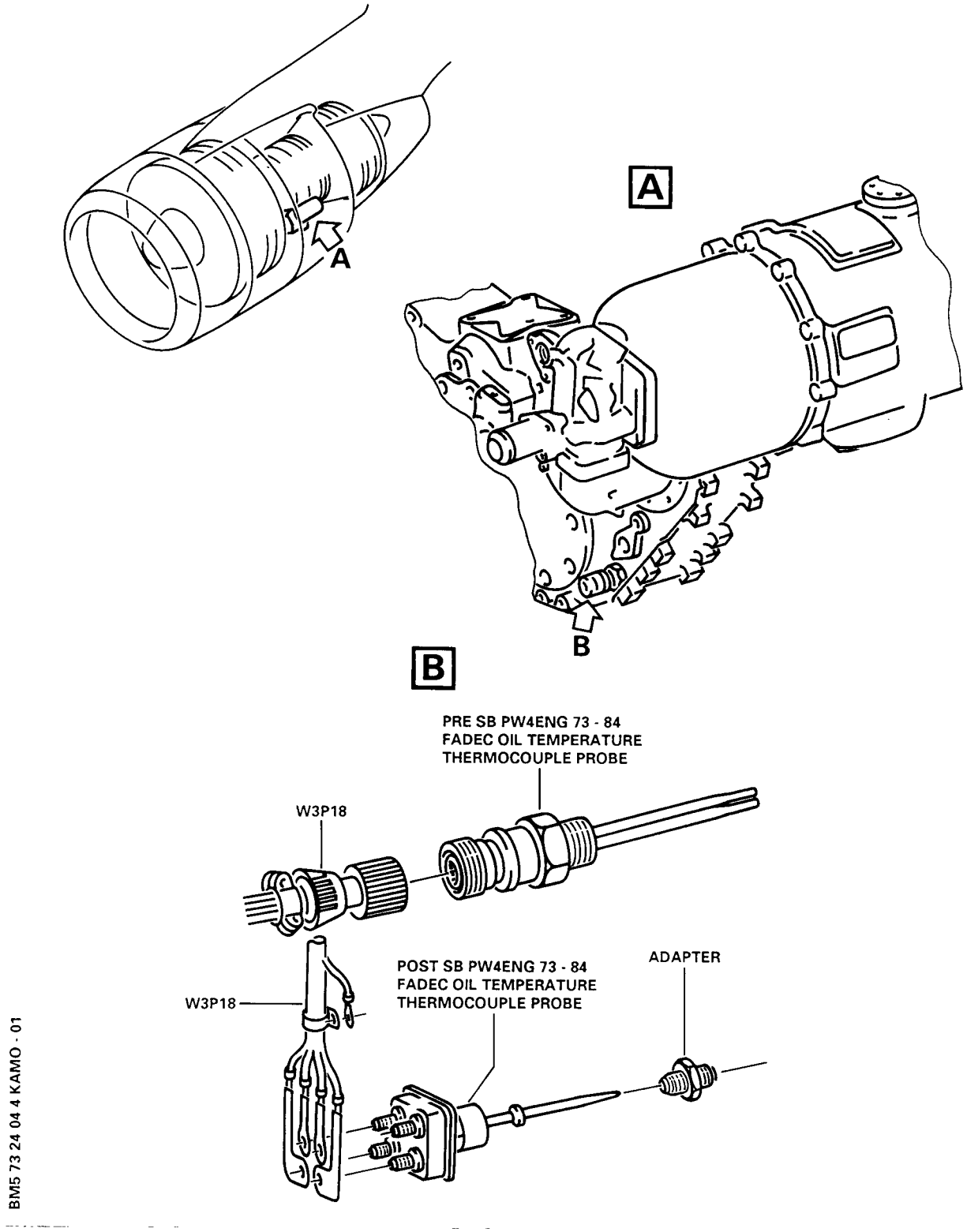
(c)Lubricate the threads of the thermocouple probe with Material No.P03-001, and install the probe into the adapter in the gearbox housing.

(d)Turn the thermocouple probe to align the thermocouple studs with the terminal on the wiring harness.

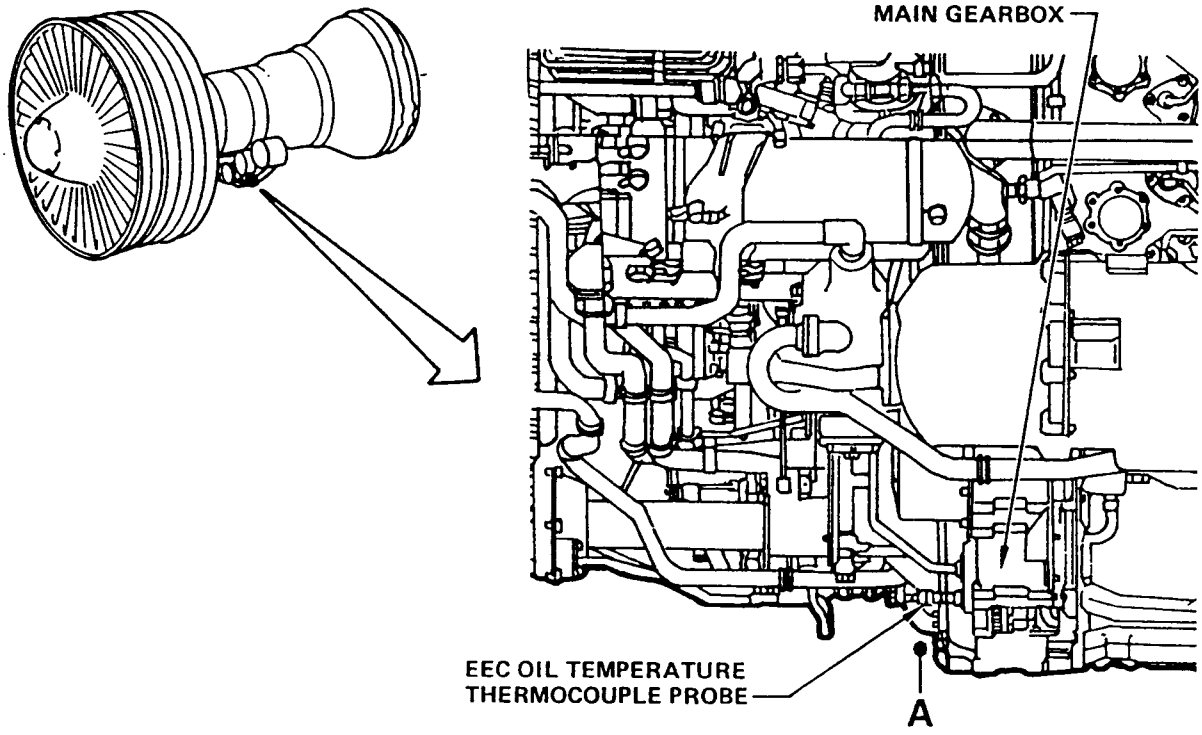
NOTE : Do not install the clamp, ground strap, and bolt to the main gearbox pressure tube (LP12) at this time.

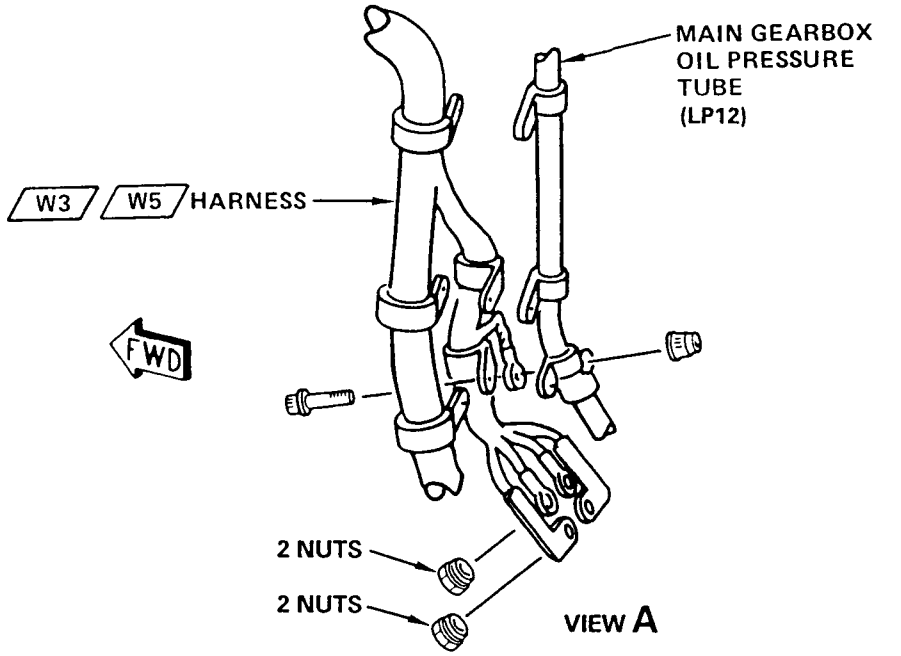
(e)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.
(f)Install the clamp, ground strap, and bolt loosely to the main gearbox pressure tube (LP12).
CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.
(g)(Reference 572) Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.
CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.
(h)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.
CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.
(i)(Reference 2163) TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).
(j)(Reference 2164) TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 amd 0.20 m.daN).
(k)Install lockwire from the coupling nut to the adapter.
(l)TORQUE the bolt that attachs the clamp and ground strap to the main gearbox pressure tube to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

D. Close-Up and Test
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(3)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(4)Remove safety clips and tags and close circuit breakers 1JH, 2JH, 8JH, 1KG, 1KM, 2KM, 4DA and 8DA.
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



FADEC Oil Temperature Thermocouple Probe
Figure 401





(POST SB PW4ENG 73 - 84)

L-A8050 (0000)

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FADEC Oil Temperature Thermocouple Probe
(Post SB PW4ENG 73-84)
Figure 402

FADEC THERMOCOUPLE PROBE (TT3) - REMOVAL/INSTALLATION

R 1. Equipment and Material

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
C.	Access Platform
D.	Gasket
E.	Torque Wrench
F. PWA 87649	Gage, Angle (To position TT3 probe)
G. Material No.P03-001	Oils (Ref. 70-00-00)
Referenced Procedures	
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant - General

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers.

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENG1-SCU SUPPLY-GND	35KS	333/T76
133VU	ENG1-SCU SUPPLY-FLT	37KS	333/T75
Engine 2			
133VU	ENG2-SCU SUPPLY-GND	34KS	333/T85
133VU	ENG2-SCU SUPPLY-FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
(3)Install access platform.

B. Removal (Ref. Fig. 401)
(1)Locate thermocouple (TT3) at approximately the 2.30 o'clock position on diffuser case.
(2)Remove nuts securing harness ends to thermocouple studs. Remove harness ends from thermocouple.
(3)Remove lockwire securing probe body nut to diffuser case. Do not remove lockwire securing coupling nut to probe body nut (see NOTE). Loosen body nut from diffuser case boss and remove probe. Remove and discard gasket. Install protective closures.
NOTE : To avoid loss of small detail washer, do not remove body nut from probe.

C. Installation (Ref. Fig. 401)
(1)Install gasket to thermocouple (TT3).
(2)Lubricate the probe threads with Material No.P03-001.
(3)Install the probe and gasket to the boss on the diffuser case at

approximately the 2:30 o'clock position behind the fuel injector bosses.

(4)If installed, remove the lockwire between the body nut and coupling nut. Loosen the coupling nut from the body nut. **TORQUE** the body nut (to the case) to between 95 and 100 lbf.in (1.08 and 1.12 m.daN). Install new lockwire from the body nut to the case.

(5)Attach the **PWA 87649** Angle Gage to the two bolt hole boss of the diffuser case on the right side (horizontal centerline) with the detail hex head screws. Move the gage guide into position.

(6)Turn the probe so the two larger studs are aligned with the top of the engine as shown in the figure. Hold the probe in place.

(7)Touch the side of the thermocouple probe with the guide and tighten the hand knob to hold the guide assembly in position. This will correctly position the thermocouple probe for the electrical harness alignment connection.

(8)**TORQUE** the coupling nut to between 95 and 100 lbf.in (1.08 and 1.12 m.daN). Install lockwire from the coupling nut to the body nut.

(9)Remove the **PWA 87649** Angle Gage from the diffuser case.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(10)Connect thermocouple harness leads to thermocouple probe and secure with nuts (round collar end inboard). **TORQUE** nuts as follows :

(a)**TORQUE** alumel connection (larger stud) to between 18 and 22 lbf.in. (0.21 and 0.24 m.daN).

(b)**TORQUE** chromel connection (smaller stud) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

D. Close-Up and Test

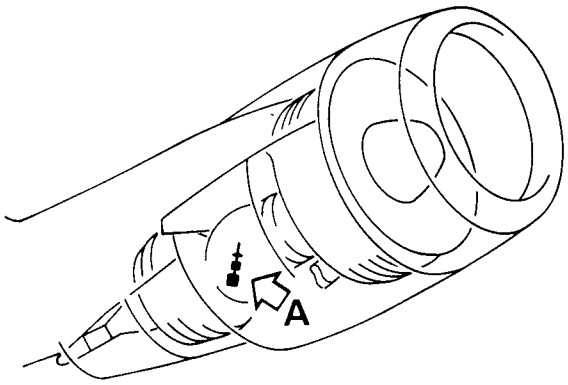
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

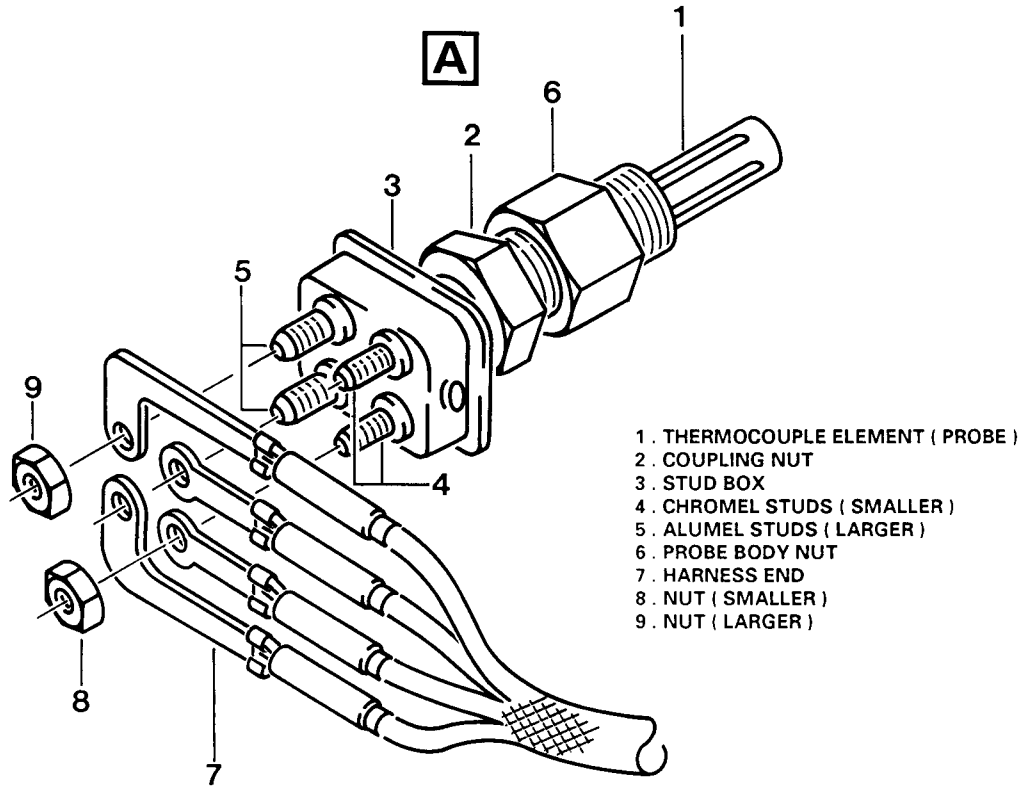
(2)Remove access platform.

(3)Close fan cowl and thrust reverser doors (Ref. 71-13-00, P. Block 301).

(4)Remove safety clips and tags and close circuit breakers 34KS, 35KS, 36KS and 37KS.

(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).





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Thermocouple (TT3)
Figure 401

AMBIENT PRESSURE SENSOR - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Covers
C.	Torque Wrench
Referenced Procedure - 71-13-00, P. Block 301	Cowl Doors

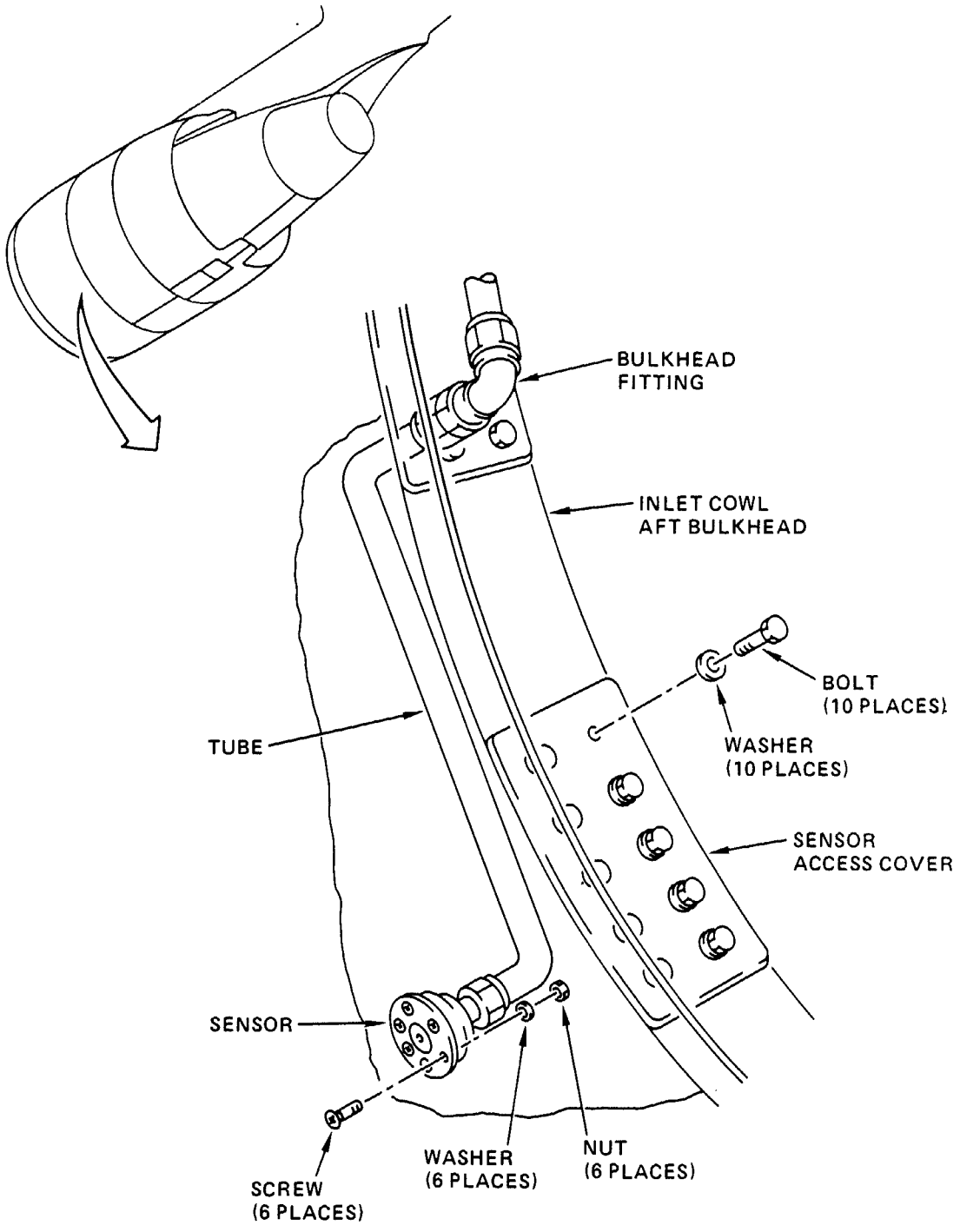
2. Procedure

A. Job Set-up
(1) Open, safety and tag the appropriate circuit breakers and open fan cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)
NOTE : There are two ambient pressure sensors mounted to the aft end of the nose cowl outer barrel. The left sensor is located at the 250 degree radial and the right sensor is located at the 110 degree radial. Access to the sensors and tubing is gained by removing covers from the nose cowl aft bulkhead.
(1) Remove 10 bolts and washers attaching left or right sensor access cover to nose cowl aft bulkhead and remove cover.
(2) Remove tube from ambient pressure sensor union and bulkhead fitting. Install protective covers over both ends of tube, bulkhead fitting and sensor union.
(3) Remove six nuts, washers and screws attaching sensor to nose cowl outer barrel and remove sensor.

C. Installation (Ref. Fig. 401)
R NOTE : Refer to chapter 77 in PPIPC for component information.
(1) Attach ambient pressure sensor to back side of nose cowl outer barrel with six screws, washers and nuts. TORQUE nuts to between 10 and 11.5 lbf.in. (0.11 and 0.13 m.daN) using opposite bolt tightening sequence.
(2) Remove protective covers from sensor union, tube ends and bulkhead fitting.
(3) Connect tube to sensor union and bulkhead fitting. TORQUE both coupling nuts to between 270 and 300 lbf.in. (3.05 and 3.39 m.daN).
(4) Install access cover on nose cowl aft bulkhead with 10 bolts and washers. TORQUE bolts to between 32 and 36 lbf.in. (0.36 and 0.41 m.daN).

D. Close-Up
(1) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2) Close fan cowl doors (Ref. 71-13-00, P. Block 301).



Ambient Pressure Sensor
Figure 401

(3)Remove safety clips and tags and close circuit breakers.

FADEC INLET PRESSURE/TEMPERATURE (PT2/TT2) PROBE - REMOVAL/INSTALLATION

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform
B.	Circuit Breaker Safety Clips
C.	Torque Wrench
D.	Teflon or Plastic Spatula
E. Material No.P05-005	Special Materials (Ref. 70-00-00)
F. Material No.P05-015	Special Materials (Ref. 70-00-00)
G. Material No.P05-252	Special Materials (Ref. 70-00-00)
H. Material No.P09-013	Sealants (Ref. 70-00-00)
J. Material No.P11-005	Cleaning Agents (Ref. 70-00-00)
K. Material No.P11-014	Cleaning Agents (Ref. 70-00-00)
Referenced Procedures	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors

R 2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers (Ref. 71-13-00, P. Block 301).

PANEL	SERVICE	IDENT.	LOCATION
FOR ENGINE 1			
132VU	ANTI ICE/PROBES CAPT ENG1	85DA	325/K67
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
FOR ENGINE 2			
132VU	ANTI ICE/PROBES F/O ENG2	86DA	323/M70
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(2)Install access platform.

B. Removal (Ref. Fig. 401)

(1)Remove the sealant between the inner barrel and PT2/TT2 probe using a teflon or plastic spatula. Abrade and clean the area with Scotchbrite Pad (Material No.P05-252) moistened with Isopropyl Alcohol (Material No.P11-014).

(2)Gain access to probe by removing 12 bolts and access panel on upper right side of nose cowl.

(3)Disconnect electrical connectors DH11A and DH11B. Install protective covers on connectors and receptacles.

(4)Remove pneumatic pressure line from probe and install protective covers on line and probe fitting.

(5)Remove six bolts and washers attaching probe to inner cowl barrel

mounting bracket and remove probe.

C. Installation (Ref. Fig. 401)

(1) Position probe on nose cowl inner barrel mounting bracket and align boltholes.

(2) Using longer bolt with washer, attach bonding wire terminal to inlet probe flange at a forward mounting bolthole position.

(3) Install five remaining mounting bolts and washers. TORQUE all six bolts to between 32 and 36 lbf. in. (0.36 and 0.41 m.daN).

CAUTION : DO NOT USE LUBRICANTS ON FADEC SENSING TUBES, ADAPTERS, OR PACKINGS. CONTAMINATION OF FADEC CAN OCCUR.

(4) Remove protective covers from pneumatic pressure line and inlet probe fitting. Connect pressure line coupling nut to probe fitting. TORQUE coupling nut to between 90 and 100 lbf. in. (1.02 and 1.13 m.daN).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(5) Connect electrical connectors DH11A and DH11B to probe (Ref. 70-00-00, P. Block 201).

(6) Reinstall access cover on nose cowl with 12 bolts. Sequentially TORQUE bolts to between 32 and 36 lbf. in. (0.36 and 0.41 m.daN).

(7) Clean the fillet gap surface area between the PT2/TT2 probe and the inner barrel surface with a clean cotton cloth (Material No.P05-005) moistened with Solvent (Material No.P11-005). Wipe the surface dry before the solvent evaporates.

(8) Use a clean cotton cloth (Material No.P05-005) to apply a thin coat of Primer (Material No.P05-015) to the cleaned area.

(9) Allow the Primer (Material No.P05-015) to dry for 30 minutes at 77°F (25°C).

(10) Apply the Sealant (Material No.P09-013) to the fillet gap between the PT2/TT2 probe and the inner barrel surface. Make sure the Sealant (Material No.P09-013) is flush to the surface within 0.01 in. (0.25mm).

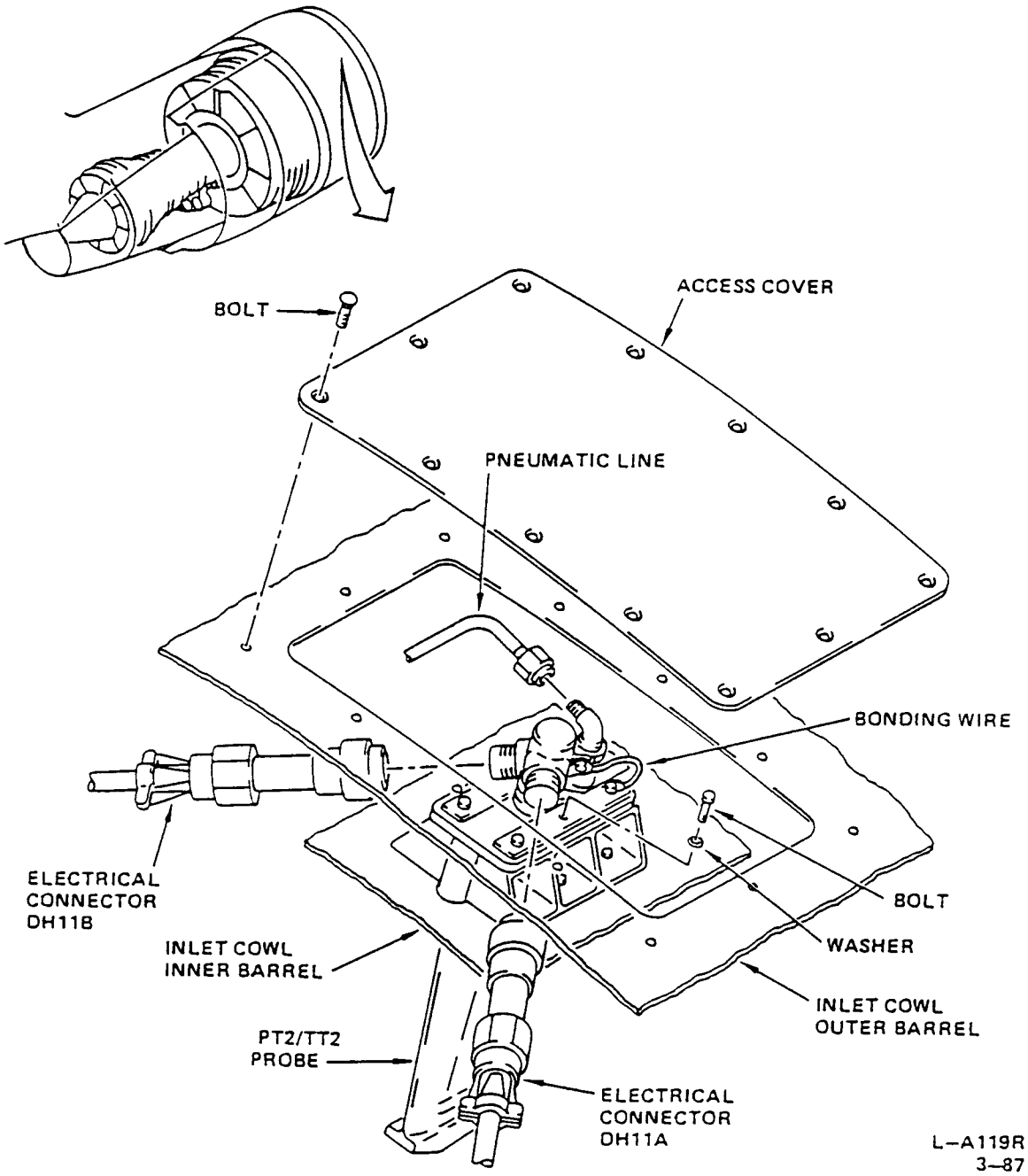
(11) Cure the Sealant (Material No.P09-013) for 10 hours at room temperature or force the cure by allowing the sealant (Material No.P09-013) to gel at room temperature for a minimum of two hours followed by another two hours at between 100 and 120°F (38 and 49°C) and 50% minimum relative humidity.

D. Close-Up

(1) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2) Remove access platform.

(3) Remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301) : 85DA, 35KS, 37KS, 86DA, 34KS, 36KS.



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FADEC - Inlet Pressure/Temperature (PT2/TT2) Probe
Figure 401

FADEC ENGINE ELECTRICAL HARNESS - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Access Platform
C. PWA85749	Torque Adapter Electronic Harness Connectors
D. Material No.P03-001	Oils (Ref. 70-00-00)
E. Material No.P05-124	Special Materials (Ref. 70-00-00)
F.	Corrosion Resistant Steel Lockwire (AS3214-01) (MS9226-03) (Ref. 70-00-00)
Referenced Procedure	
- 70-00-00, P. Block 201	Standard Practices
- 71-13-00, P. Block 301	Cowl Doors

2. FADEC Thermocouple and Airframe Cable (W6) (PRE SB PW4 ENG 72-134)

NOTE : This procedure provides for removal/installation of FADEC thermocouple and airframe cable (W6) and wiring harness tube support (PRE SB PW4 ENG 72-134).

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.A.	19KS	332/U70
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.B.	21KS	331/V70
133VU	ENG1 - SCU SUPPLY - GND	35KS	333/T76
133VU	ENG1 - SCU SUPPLY - FLT	37KS	333/T75
Engine 2			
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.A.	18KS	332/U71
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.B.	20KS	331/V69
133VU	ENG2 - SCU SUPPLY GND	34KS	333/T85
133VU	ENG2 - SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

(1)Before disconnecting cable leads, tag each lead and terminal stud to facilitate proper reinstallation.

CAUTION : AVOID TWISTING OR SEVERE BENDING OF CABLE AT ANY TIME DURING REMOVAL OR DAMAGE TO CABLE MAY RESULT.

(2)Remove lockwire and four screws securing cover and ground lead to EGT (TT4.95) box and cable assembly junction box located at 5.30 o'clock position on exhaust case. Remove cover.

(3)Remove four nuts and disconnect cable leads from junction box. Reinstall nuts on terminal studs.

NOTE : Chromel nut and terminal stud diameters are smaller than those of

alumel nuts and terminal studs.

(4)Remove four nuts and disconnect cable leads from TT3 thermocouple located at approximately 3 o'clock position on diffuser case. Reinstall nuts on terminal studs.

NOTE : Chromel nut and terminal stud diameters are smaller than those of alumel nuts and terminal studs.

(5)Disconnect W6P12 cable connector from W5J12 harness connector located on Flange K at 3.30 o'clock position. Install protective closures on each harness/cable connector.

(6)Remove nuts and bolts securing cable clamps at brackets and to wiring harness tube (support). Remove cable.

(7)Remove nut and bolt securing forward end of wiring harness tube (support) to bracket at No. 7 fuel nozzle.

(8)Remove nut and bolt securing lower rear end of wiring harness tube (support) to bracket located on Flange P at approximately 5 o'clock position. Remove wiring harness tube (support).

C. Installation

(1)Install wiring harness tube (support).

(a)Position tube to engine with brazed clamp at shorter straight end of tube against upper face of bracket at No. 7 fuel nozzle. Position other end of tube to outer face of bracket located on Flange P, at 5 o'clock position.

(b)Secure brazed clamp on tube to bracket at No. 7 fuel nozzle with bolt, threads lubricated with Material No.P03-001, (bolthead up next to clamp on tube) and nut handtight. See View H. (Ref. Fig. 401) (Sheet 5/6).

NOTE : Bolt securing brazed clamp to bracket at No. 7 fuel nozzle will be torqued in a later step.

(c)Secure brazed clamp on other end of tube to lower hole on outer face of bracket on Flange P with bolt, threads lubricated with Material No.P03-001, head outboard next to clamp on tube) and nut. Tighten and TORQUE bolt to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN). See View B. (Ref. Fig. 401) (Sheet 2/6).

CAUTION : AVOID TWISTING OR SEVERE BENDING OF WIRING HARNESSES AT ANY TIME DURING INSTALLATION OR DAMAGE TO HARNESSES MAY RESULT.

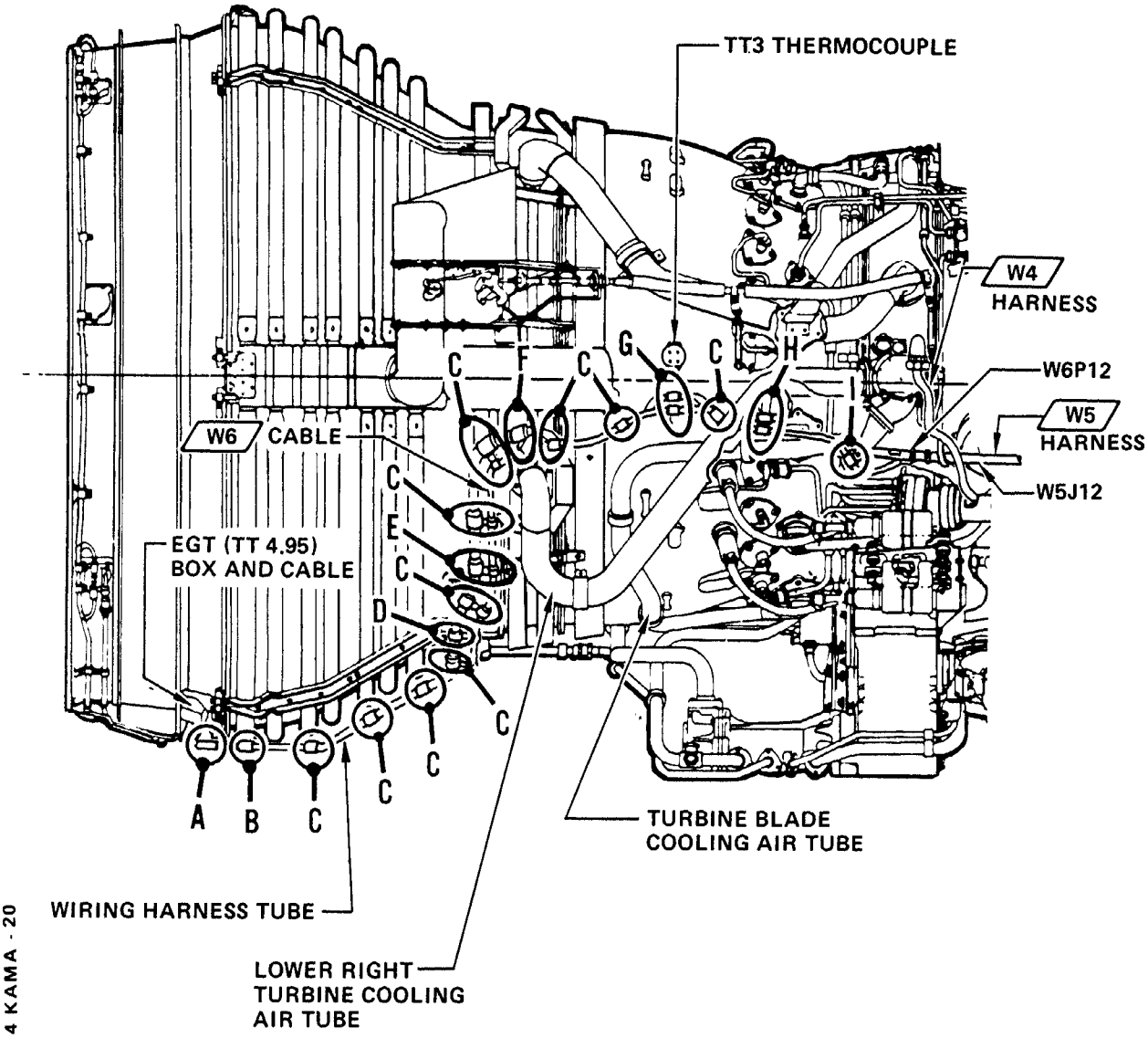
(2)Install FADEC thermocouple and airframe cable (W6).

(a)Remove protective closures. Connect W6P12 cable connector (Ref. 70-00-00, P. Block 201) to W5J12 harness connector attached to large fuel manifold support bracket located on Flange K at 3.30 o'clock position.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

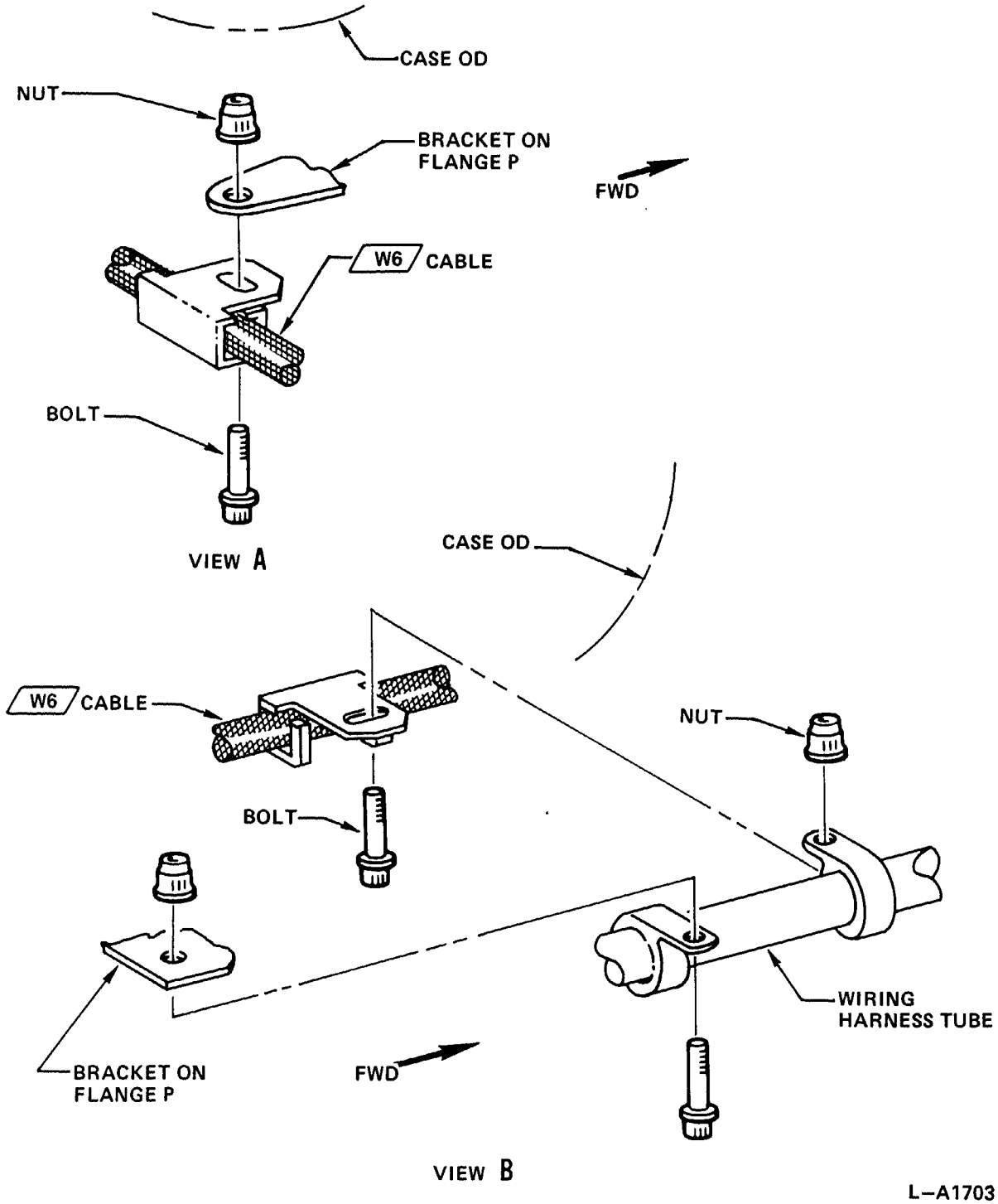
(b)Route cable upward and rearward over bracket secured at turbine blade cooling air tube flange on valve located at 3 o'clock position. Route cable inboard of lower right turbine cooling air tube.

(c)Secure second clamp on cable to lower face of bracket securing wiring

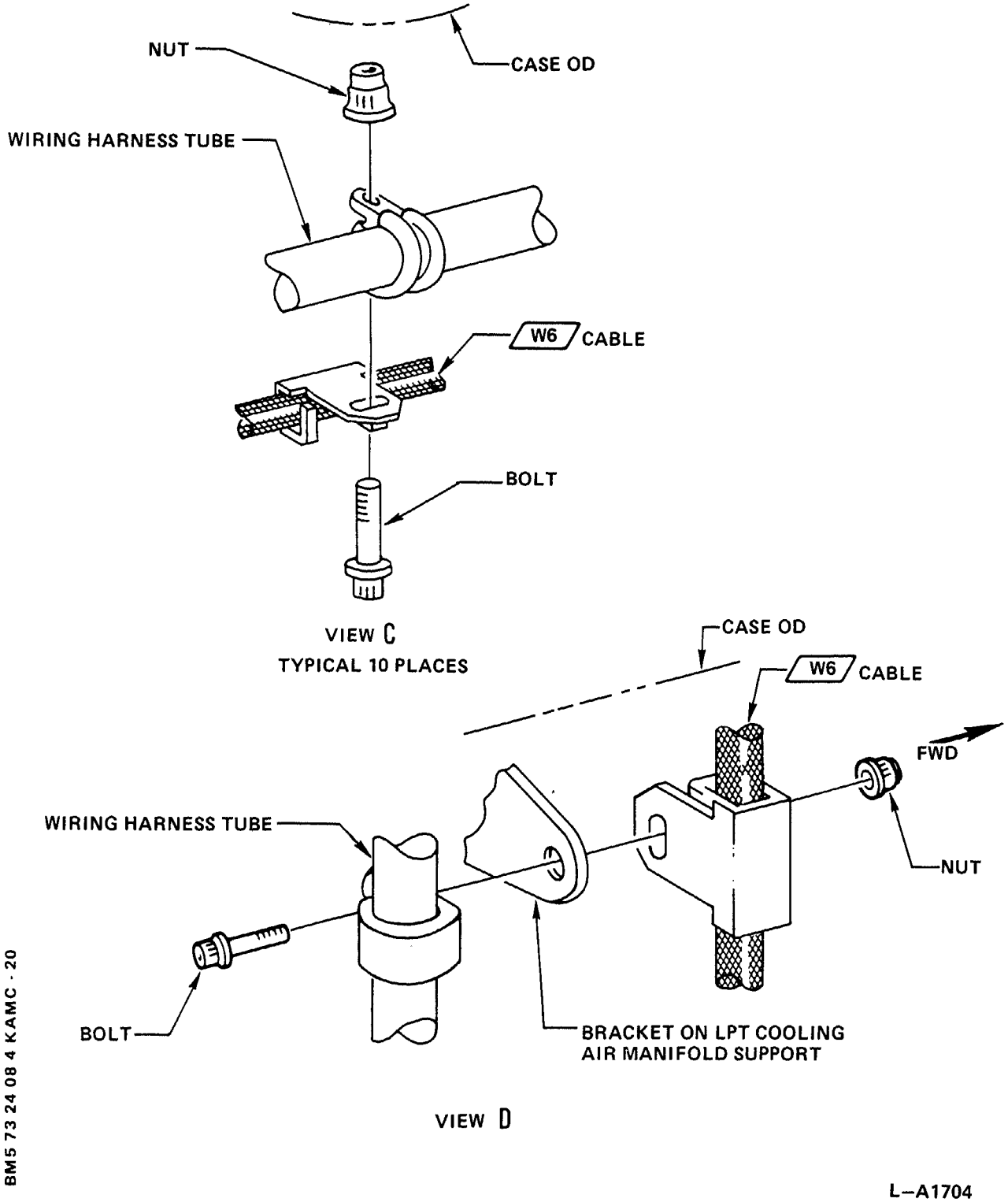


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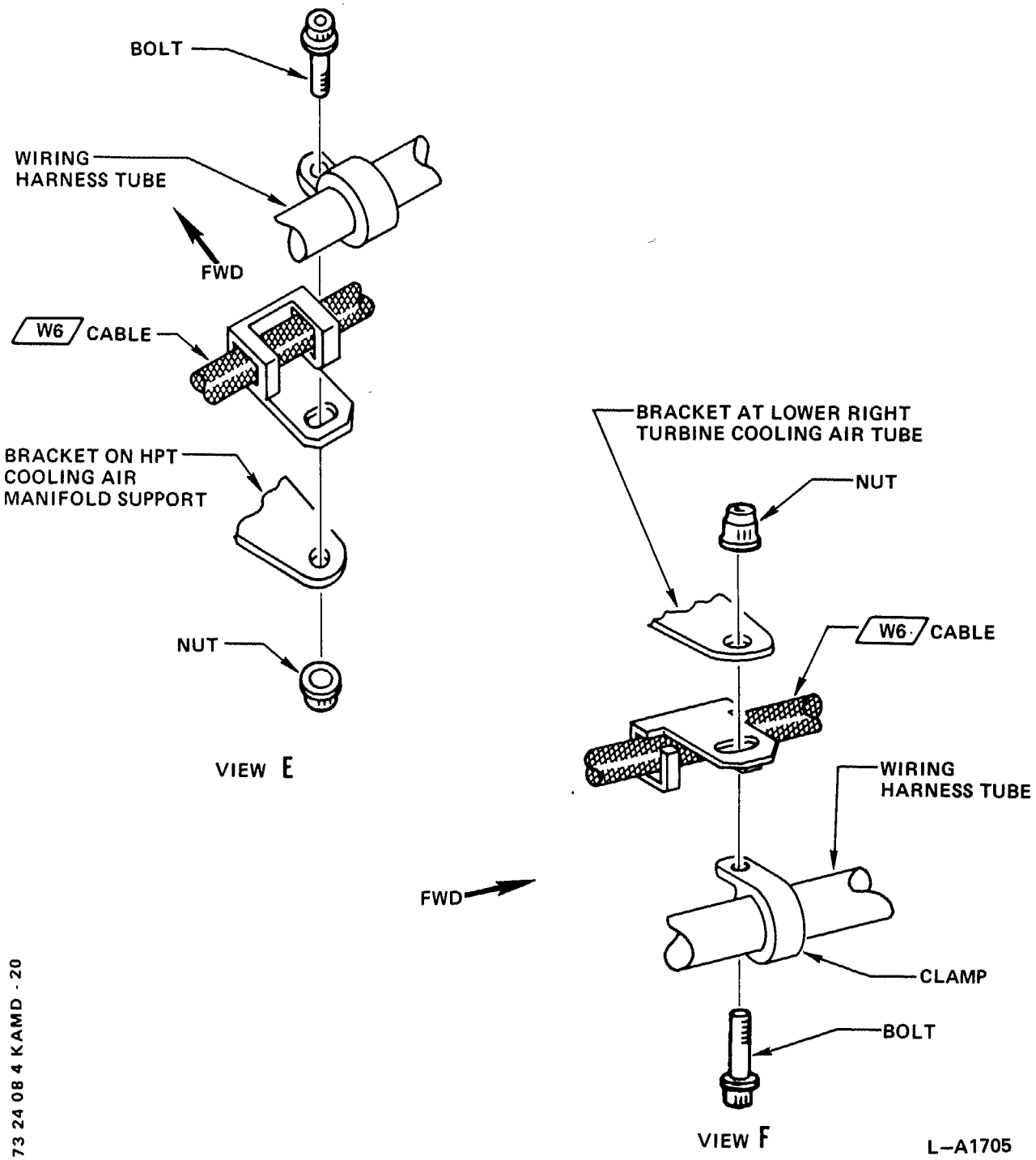
FADEC Thermocouple and Airframe Cable (W6) (Sheet 1/6)
Figure 401



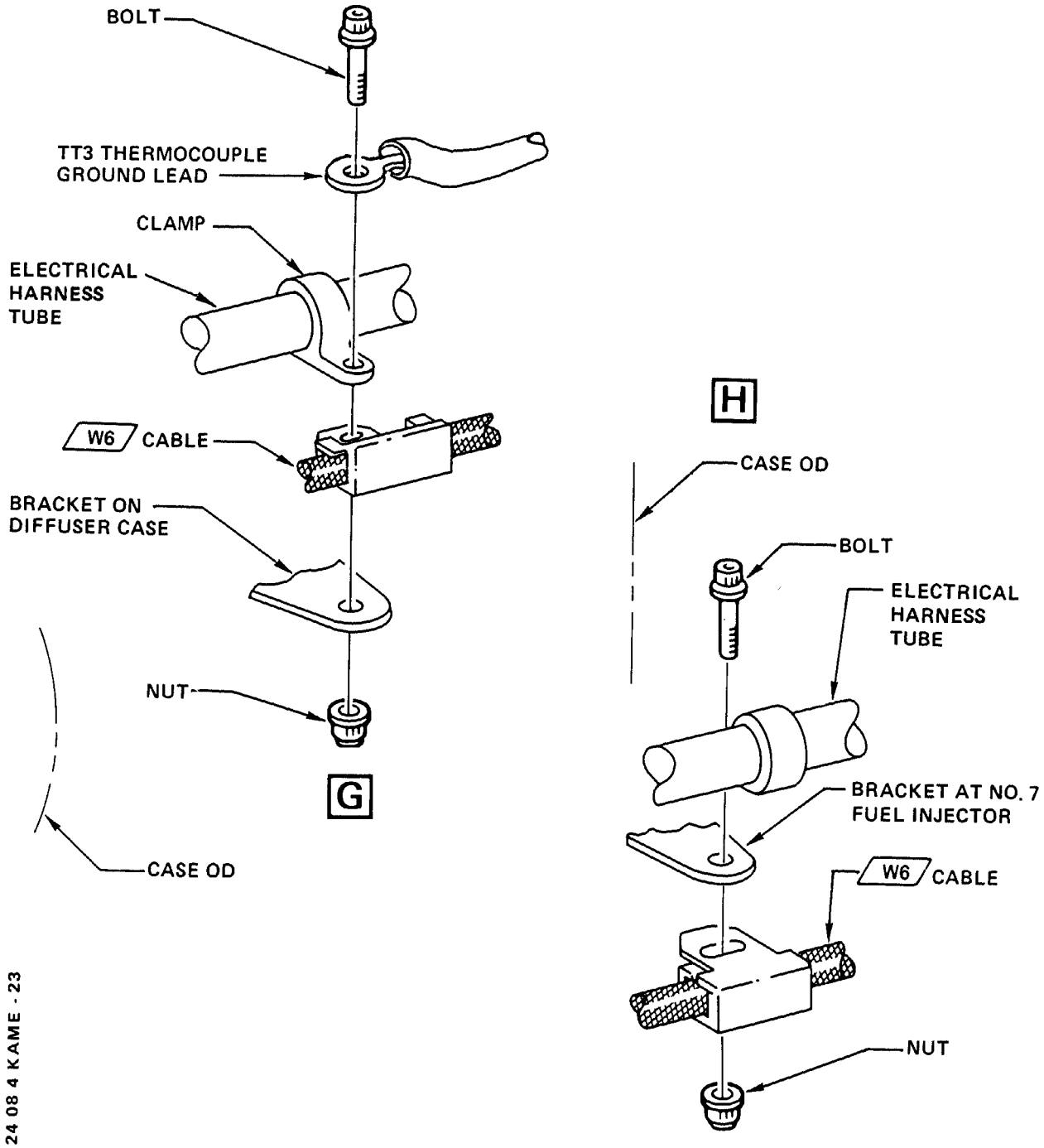
FADEC Thermocouple and Airframe Cable (W6) (Sheet 2/6)
Figure 401



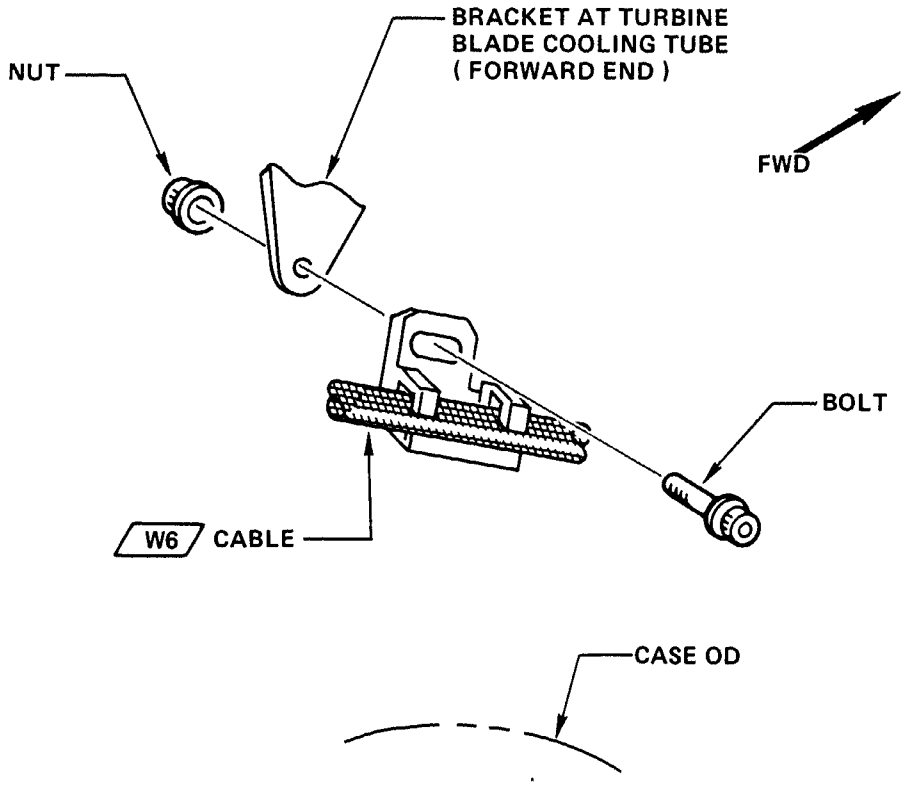
FADEC Thermocouple and Airframe Cable (W6) (Sheet 3/6)
Figure 401



FADEC Thermocouple and Airframe Cable (W6) (Sheet 4/6)
Figure 401



FADEC Thermocouple and Airframe Cable (W6) (Sheet 5/6)
Figure 401



VIEW I

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FADEC Thermocouple and Airframe Cable (W6) (Sheet 6/6)
Figure 401

harness tube to bracket at No. 7 fuel nozzle. Remove nut from bolt and position cable clamp over bolt. Reinstall nut handtight. See View H. (Ref. Fig. 401) (Sheet 5/6).

(d) Secure first clamp on cable to outer face of bracket at turbine blade cooling air tube flange with bolt, threads lubricated with Material No.P03-001, (bolthead outboard next to clamp and nut handtight). See View I. (Ref. Fig. 401) (Sheet 6/6).

(e) Secure third clamp on cable to brazed clamp on tube with bolt, threads lubricated with Material No.P03-001, (bolthead down next to clamp) and nut handtight. See View C. (Ref. Fig. 401) (Sheet 3/6).

(f) Secure fourth clamp on cable to lower face of bracket on diffuser case. Position TT3 thermocouple ground lead on top of brazed tube clamp. Install both, threads lubricated with Material No.P03-001, (bolthead next to ground lead) and nut handtight. See View G. (Ref. Fig. 401) (Sheet 5/6).

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(g) Remove nuts from TT3 thermocouple terminal studs. Connect thermocouple leads to terminal studs and secure with nuts (round collar end inboard). Align leads so they are parallel to one another. Torque nuts as follows :

1 TORQUE alumel nuts (larger terminal stud) to between 18 and 20 lbf.in. (0.21 and 0.24 m.daN).

2 TORQUE chromel nuts (smaller terminal stud) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(h) Secure fifth and sixth clamps on cable to brazed clamps on tube with bolts, threads lubricated with Material No.P03-001, (boltheads down next to clamps) and nuts handtight. See View C. (Ref. Fig. 401) (Sheet 3/6).

(i) Secure seventh cable clamp and brazed tube clamp to outer face of bracket attached to flange of lower right turbine cooling air tube on HPT case. Install bolt, threads lubricated with Material No.P03-001, (bolthead outboard next to brazed clamp) and nut handtight. See View F. (Ref. Fig. 401) (Sheet 4/6).

(j) Secure eighth and ninth cable clamps to brazed tube clamps with bolts, threads lubricated with Material No.P03-001, (bolthead outboard next to clamp) and nuts handtight. See View C. (Ref. Fig. 401) (Sheet 3/6).

(k) Secure tenth cable clamp and brazed tube clamp to outer face of bracket on HPT cooling air manifold support with bolt, threads lubricated with Material No.P03-001, (bolthead outboard next to brazed clamp) and nut handtight. See View E. (Ref. Fig. 401) (Sheet 4/6).

(l) Secure eleventh cable clamp to brazed tube clamp with bolt, threads lubricated with Material No.P03-001, (bolthead outboard next to clamp) and nut handtight. See View C. (Ref. Fig. 401) (Sheet 3/6).

(m) Secure twelfth cable clamp and brazed tube clamp to bracket on LPT cooling air manifold support. Install bolt, threads lubricated with Material No.P03-001, (bolthead rearward next to brazed clamp) and nut handtight. See View D. (Ref. Fig. 401) (Sheet 3/6).

(n) Secure thirteenth, fourteenth, fifteenth and sixteenth cable clamps to brazed tube clamps with bolts, threads lubricated with Material

No.P03-001, (bolthead outboard next to clamp) and nuts handtight. See View C. (Ref. Fig. 401) (Sheet 3/6).

(o)Secure seventeenth clamp to brazed tube clamp with bolt, threads lubricated with Material No.P03-001, (bolthead outboard next to clamp) and nut handtight. See View B. (Ref. Fig. 401) (Sheet 2/6).

(p)Secure last cable clamp to outer face of bracket located on Flange P, at 5 o'clock position, with bolt, threads lubricated with Material No.P03-001, bolthead outboard next to clamp) and nut handtight. See View A. (Ref. Fig. 401) (Sheet 2/6).

(q)Tighten and TORQUE all previously installed bolts and/or nuts securing cable clamps to brackets or brazed tube clamps to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN).

CAUTION : DO NOT ATTACH THE GROUND WIRE TO TERMINAL STUDS.

(r)Remove nuts from EGT (TT4.95) box and cable assembly junction box located at 5.30 o'clock position on exhaust case. Connect cable leads to terminal studs and secure with nuts. Align leads so they are parallel to one another.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(s)Torque nuts as follows :

1 TORQUE alumel nuts (larger terminal stud) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).

2 TORQUE chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(t)Install cover on junction box and secure with four screws. Secure cable ground lead under screw at front right end of cover (viewed from rear of engine). Tighten and TORQUE screws to between 16 and 22 lbf.in. (0.18 and 0.25 m.daN). Wirelock screws.

NOTE : Wirelock cover screw to clamp screw at cable end of junction box. Do not wirelock screws across cable.

D. CLose-Up

(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

(2)Remove safety clips and tags and close circuit breakers : 18KS, 19KS, 20KS, 21KS, 34KS, 35KS, 36KS, 37KS.

3. FADEC Thermocouple and Airframe Cable (W6) - (POST SB PW4 ENG 72-134)

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.A.	19KS	332/U70
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.B.	21KS	331/V70
133VU	ENG1 - SCU SUPPLY - GND	35KS	333/T76
133VU	ENG1 - SCU SUPPLY - FLT	37KS	333/T75
Engine 2			
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.A.	18KS	332/U71
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.B.	20KS	331/V69

PANEL	SERVICE	IDENT.	LOCATION
133VU	ENG2 - SCU SUPPLY GND	34KS	333/T85
133VU	ENG2 - SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 402, 403)
(Ref. Fig. 404, 405)

(1)Before you disconnect the cable wires (leads), tag each wire (lead) and terminal stud to help with the correct installation.
CAUTION : DO NOT TWIST OR BEND THE CABLE BADLY DURING REMOVAL, OR DAMAGE TO THE CABLE CAN OCCUR.

(2)Remove the lockwire and the four screws that attach the cover and the ground wire (lead of the EGT (TT 4.95) box and cable assembly to the junction box at the 5:30 o'clock position on the turbine exhaust case. Remove the cover (Ref. Fig. 405)

(3)Remove the four nuts and disconnect the cable wires (leads) from the terminal studs on the junction box. Install the nuts back onto the terminal studs.
NOTE : The diameter of the chromel nuts and terminal studs is smaller than the diameter of the alumel nuts and terminal studs.

(4)Remove the four nuts and disconnect the cable wires (leads) from the TT3 thermocouple on the diffuser case at approximately the 3 o'clock position. Install the nuts back onto the terminal studs. See view M.
NOTE : The diameter of the chromel nuts and terminal studs is smaller than the diameter of the alumel nuts and terminal studs.

(5)Disconnect the W6 P12 cable connector from the W5 J12 cable connector.
(a)(Pre SB PW4ENG 73-163) Connectors are on a bracket outboard of flange K at the 3 o'clock position. Install protective closures on each harness/cable connector.
(b)(Post SB PW4ENG 73-163) Connectors are on the TCA tube flange bracket on the turbine blade cooling air tube (lower right) (AP37) flange at the 3 o'clock position.
1 (Post SB PW4ENG 73-192) Loosen clamp that attaches the cooling hose to the cooling shield around the W6 P12 connector. Remove cooling hose from the cooling shield.(Ref. Fig. 404) (Sheet 17/17).
NOTE : Pre SB PW4ENG 73-192 engines do not have the W5/W6 wiring harness connector cooling.
2 (Post SB PW4ENG 73-192) Loosen and remove the clamp attaching the two halves of the cooling shield around the W6 P12 connector. Remove the shields and clamp from the connector.
3 Disconnect W6 P12 cable connector from W5 J12 cable connector.
4 Install protective closures on each harness/cable connector.

(6)Remove the nuts, bolts, and cable clamps that attach the cable to brackets on Flange P. See Views A and B.

(7)Remove the nuts, bolts, and cable clamps from brackets and from clamps brazed on the cable tube (support). Remove cable.

(8)Remove the nut, bolt, and clamp that attach the cable tube (support) to a bracket on the turbine cooling air support at approximately the 5 o'clock

position. See View D.

(9)Remove the nut, bolt, and clamp that attach the cable tube (support) to a bracket on the high turbine cooling air manifold support at approximately the 4 o'clock position. See View H.

(10)Remove the nut, bolt, and clamp that attach the cable tube (support) to a bracket on the lower right turbine cooling air tube at approximately the 3:30 o'clock position. Remove the cable tube (support). See View J.

C. Installation (Ref. Fig. 402, 403)
(Ref. Fig. 404, 405)

(1)Install the cable tube (support).

(a)Place the tube to the engine with the longer straight end of the tube to the bottom side of the bracket on Flange P at approximately the 5:30 o'clock position. Place the other end of the tube under the bracket attached to the turbine blade cooling air tube (forward end) (Ref. Fig. 404). Pre SB PW4ENG 73-163, see sheet 3/17 view B and sheet 11/17 view Q. Post SB PW4ENG 73-163, see sheet 3/17 view B and sheet 16/17 section Z-Z.

(b)Attach the tube to a bracket on the lower right turbine cooling air tube on the high turbine with a clamp, bolt, and nut. Lubricate the threads of the bolt with Material No.P03-001. Tighten the nut by hand. See View J.

(c)Attach the tube to a bracket on the high turbine cooling air manifold support at approximately the 4:30 o'clock position with a clamp, bolt, and nut. Lubricate the threads of the bolt with Material No.P03-001. Tighten the nut by hand. See View H.

(d)Attach the tube to a bracket on the low turbine cooling air manifold support at approximately the 5 o'clock position with a clamp, bolt, and nut. Lubricate the threads of the bolt with Material No.P03-001. Tighten the nut by hand. See View D.

NOTE : Bolts that attach the cable tube (support) to the brackets will be torqued in a later step.

CAUTION : DO NOT TWIST OR BEND THE CABLE BADLY DURING INSTALLATION, OR DAMAGE TO THE CABLE CAN OCCUR.

(2)Install the FADEC thermocouple and airframe cable (W6).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (Ref. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(a)Remove the protection covers from the cable connectors. Connect the W6 P12 cable connector to the W5 J12 cable connector attached to a large fuel manifold support bracket on Flange K at the 3:30 o'clock position (Ref. 70-00-00, P. Block 201).

(b)Place (route) the cable up and rearward above a bracket attached to the forward end of the turbine blade cooling air tube Flange on a valve at the 3 o'clock position. Place the cable inboard of the forward end of the lower right turbine cooling air tube.

(c)Place the first cable clamp to the outboard side of the bracket on the

turbine blade cooling air tube flange.
Place the cable tube (support) with a clamp to the inboard side of the bracket. Attach the clamps to the bracket with a bolt, threads lubricated with Material No.P03-001 and a nut tightened by hand. See View Q.

(d)Place the second cable clamp to the top of the first attached (brazed) tube clamp.
Attach the cable clamp to the tube clamp with a bolt, threads lubricated with Material No.P03-001 and a nut tightened by hand. See View P.

(e)Place the cable tube (support) with a clamp to the outboard side of the bracket at the No. 7 fuel nozzle. Place the third cable clamp to the clamp on the tube. Attach the clamps to the bracket with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View O.

(f)Place the fourth cable clamp to the top side of the second attached (brazed) tube clamp.
Place the ground wire (lead) of the cable to the top of the fourth cable clamp. Place the fifth cable clamp to the bottom side of the tube clamp. Attach the ground wire and cable clamps to the tube clamp with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View M.
NOTE : The fourth cable clamp is attached to the cable (lead) which has attached the TT3 thermocouple wire (leads).
CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(g)Remove the nuts from the TT3 thermocouple terminal studs. Connect the thermocouple wires (leads) to the terminal studs and install the nuts (round end of the nut inboard). Align the wires (leads) so they are parallel to each other. TORQUE the nuts as follows :
1 TORQUE the alumel nuts (large terminal stud) to between 18 and 22 lbf.in. (0.21 and 0.24 m.daN).
2 TORQUE the chromel nuts (smaller terminal stud) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(h)Place the cable tube (support) with a clamp to the top side of the bracket on the diffuser case at the 3 o'clock position.
Place the sixth cable clamp to the bottom side of the bracket.
Attach the clamps to the bracket with a bolt, threads lubricated with Material No.P03-001 and a nut tightened by hand. See View N.

(i)Place the seventh cable clamp to the forward side of the third attached (brazed) tube clamp.
Attach the clamps together with a bolt, threads lubricated with Material No.P03-001 and a nut tightened by hand. See View L.

(j)Place the eigth cable clamp to the bottom side of the fourth attached (brazed) tube clamp.
Attach the clamps together with a bolt, threads lubricated with Material No.P03-001 and a nut tightened by hand. See View K.

(k)Place the nineth cable clamp to the bottom side of the fifth attached (brazed) tube clamp.
Attach the clamps together with a bolt, threads lubricated with

Material No.P03-001 and a nut tightened by hand. See View I.

(l)Place (route) the cable down along the cable tube (support).
Place the following cable clamps to the outboard side of the following attached (brazed) tube clamps :

1 Place the tenth cable clamp to the sixth clamp of the tube.
2 Place the eleventh cable clamp to the seventh clamp of the tube.
3 Place the twelfth cable clamp to the eighth clamp of the tube.
4 Attach the cable clamps to the tube clamps with bolts, lubricated with Material No.P03-001 and nuts tightened by hand. See View G.

(m)Place the thirteenth cable clamp to the rear side of the nineth attached (brazed) tube clamp.
Attach clamps together with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View F.

(n)Place the fourteenth cable clamp to the bottom side of the tenth attached (brazed) tube clamp.
Attach clamps together with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View E.

(o)Place (route) the cable rearward along the cable tube (support).
Place the following cable clamps to the bottom side of the following attached (brazed) clamps of the cable tube (support) :

1 Place the fifteenth cable clamp to the eleventh clamp of the tube.
2 Place the sixteenth cable clamp to the twelfth clamp of the tube.
3 Attach the cable clamps to the tube clamps with bolts, lubricated with Material No.P03-001 and nuts tightened by hand. See View C.

(p)Place the slotted hole in the bracket (ear) on the tube part of the cable to the bottom side of the thirteenth attached (brazed) tube clamp.
Attach clamps together with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View B.

(q)Place the end of the cable tube (support) with a clamp to the bottom side of the bracket on Flange P at approximately the 5:30 o'clock position. Place the remaining slotted hole in the bracket (ear) of the tube part at the end of the cable to the bottom side of the tube clamp.
Attach clamps to bracket with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View B.

(r)Place the seventeenth (last) cable clamp to the top side of the bracket on Flange P at approximately the 6 o'clock position. Attach the clamp to the bracket with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View A.

(s)Install a clamp on the cable and place the clamp with the cable to the top side of the same bracket on Flange P. Attach the clamp to the bracket with a bolt, lubricated with Material No.P03-001 and a nut tightened by hand. See View A.

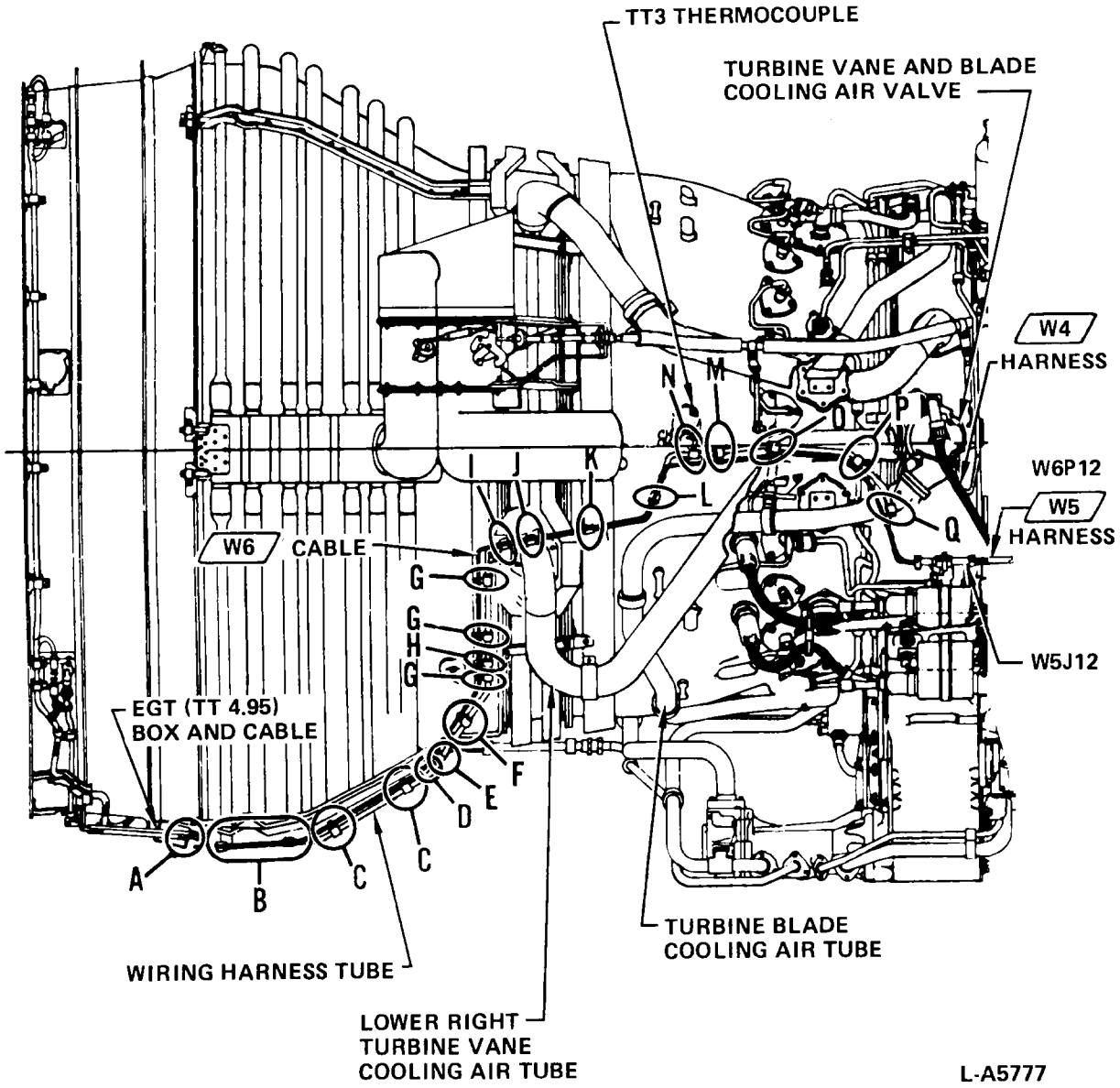
(t)Tighten and TORQUE all of the last installed bolts and/or nuts attached to the cable and the cable tube (support) to brackets, or attached (brazed) tube clamps to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(u)Remove the nuts from the terminal studs of the EGT (TT 4.95) junction box at the 5:30 o'clock position. Connect the cable wires (leads) to the terminal studs and attach with the nuts. Align the wires (leads) so they are parallel to each other.
(Ref. Fig. 405)
NOTE : Do not attach the ground wire to the terminal studs.
TORQUE the nuts as follows :
1 TORQUE the alumel nuts (large terminal stud) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).
2 TORQUE the chromel nuts (small terminal stud) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

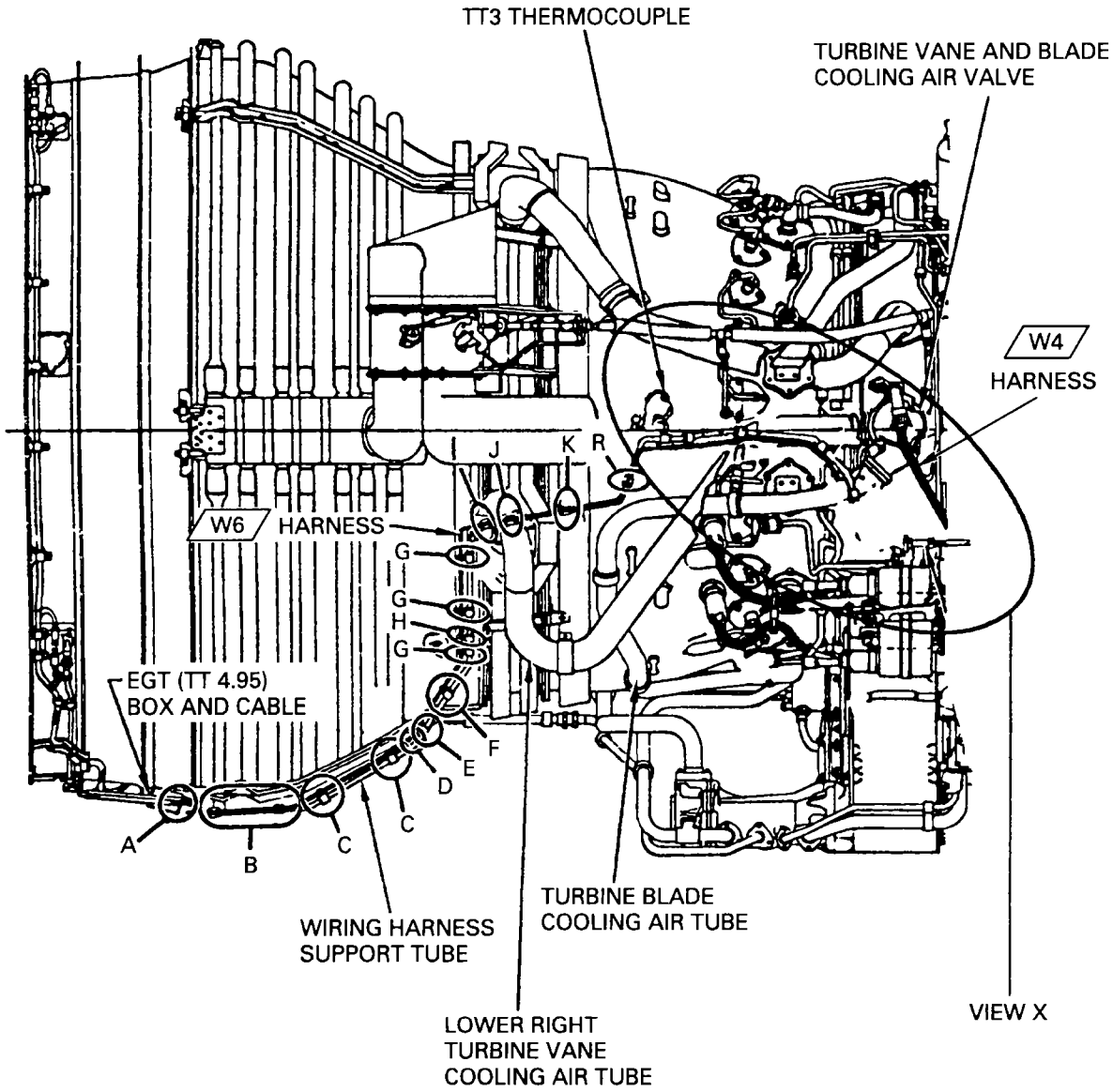
(v)Install the cover on the juction box and attach with three screws. Place the ground wire (lead) to the rear right side of the cover (viewed from the rear) and attach with a screw. Tighten and TORQUE the screws to between 16 and 22 lbf.in. (0.18 and 0.25 m.daN). Wirelock the screws.
NOTE : Wirelock the cover screws to the clamp screw at the cable end of the junction box. Do not wirelock the screws across the cable.

D. CLose-Up
(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(2)Remove safety clips and tags and close circuit breakers : 18KS, 19KS, 20KS, 21KS, 34KS, 35KS, 36KS, 37KS.



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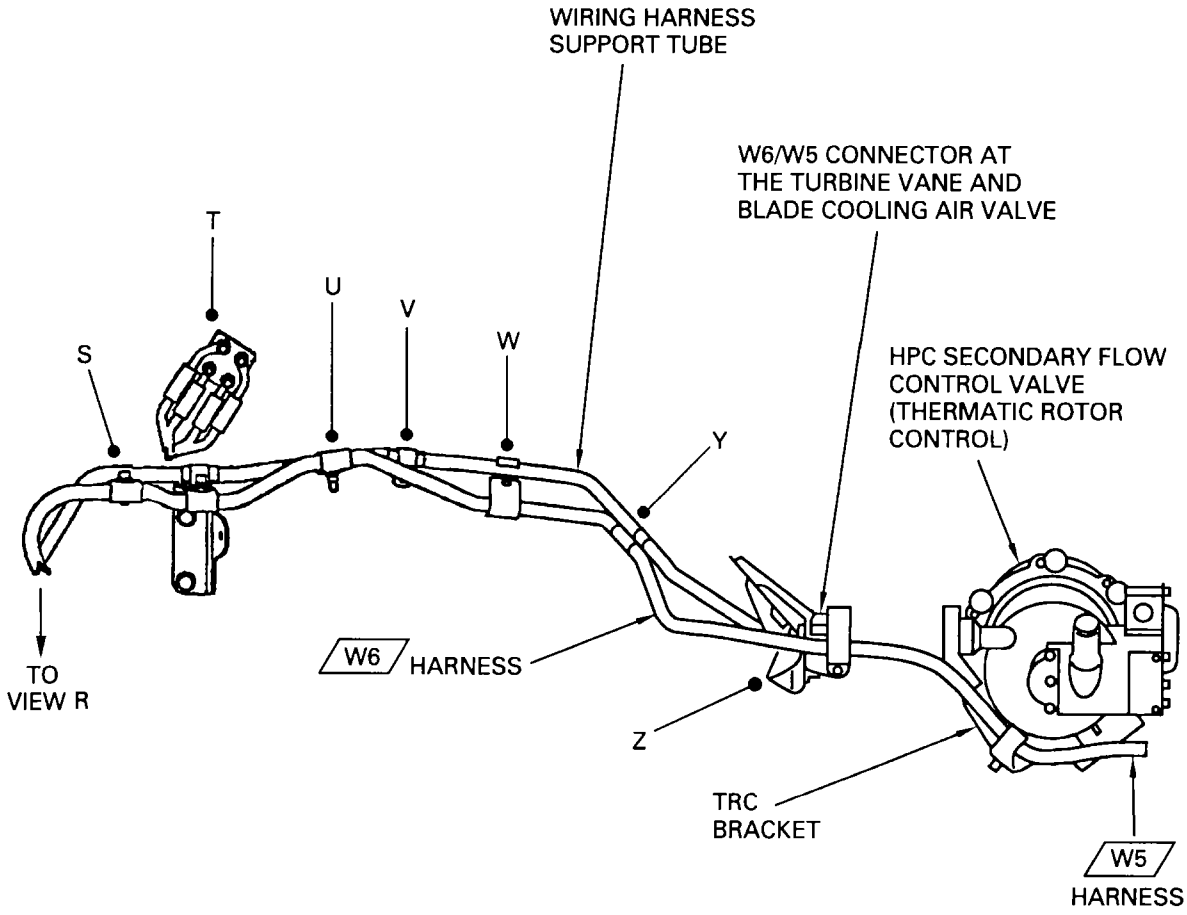
FADEC Thermocouple and Airframe Cable (W6)
(Pre SB PW4ENG 73-163)
Figure 402



L-B2651 (0000)

BM5 73 24 08 4 KAN0 00

FADEC Thermocouple and Airframe Cable (W6)
(Post SB PW4ENG 73-163)
Figure 403

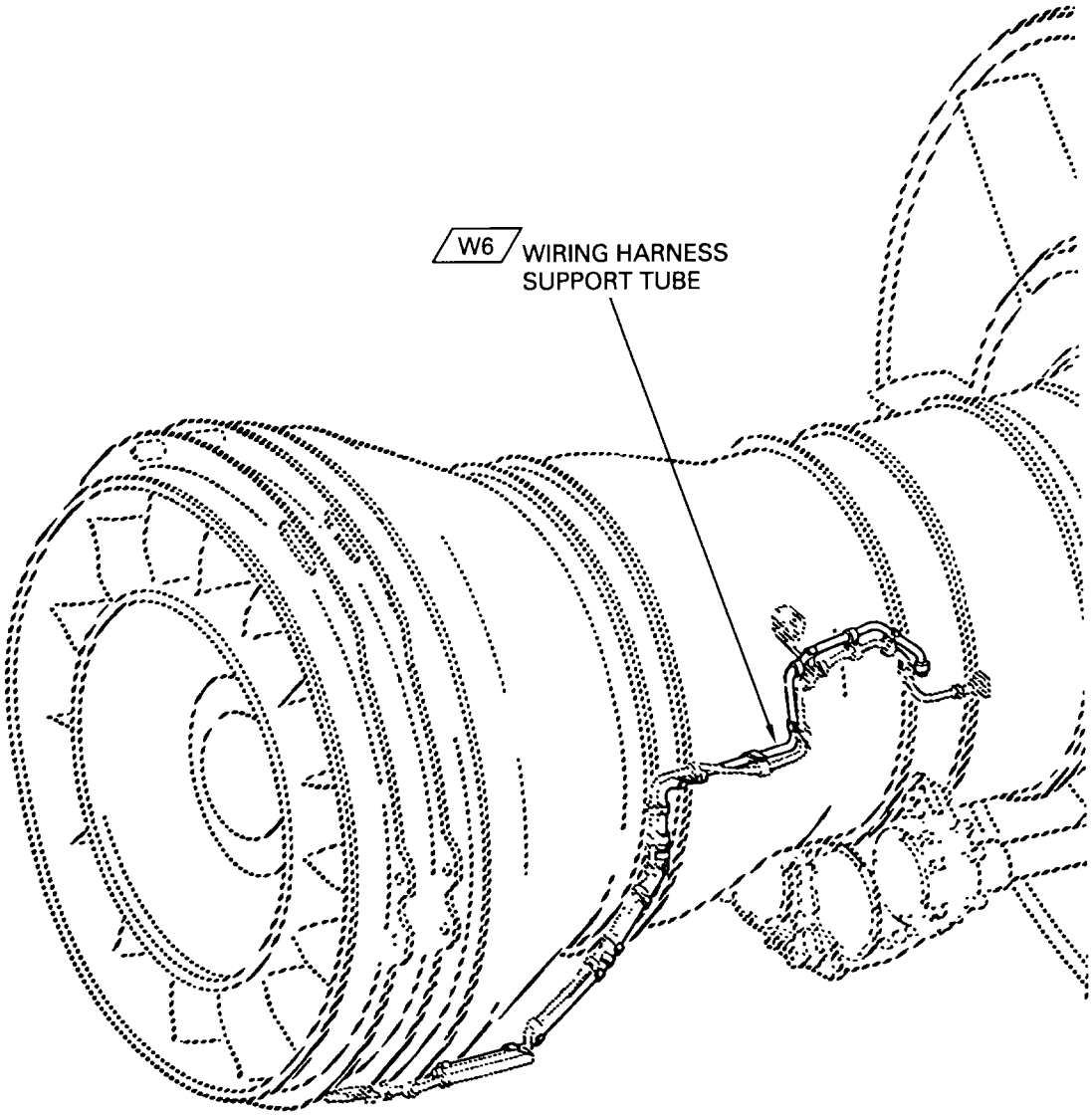


VIEW X

BM5 73 24 08 4 KBMA 01

L-B2716 (0201)

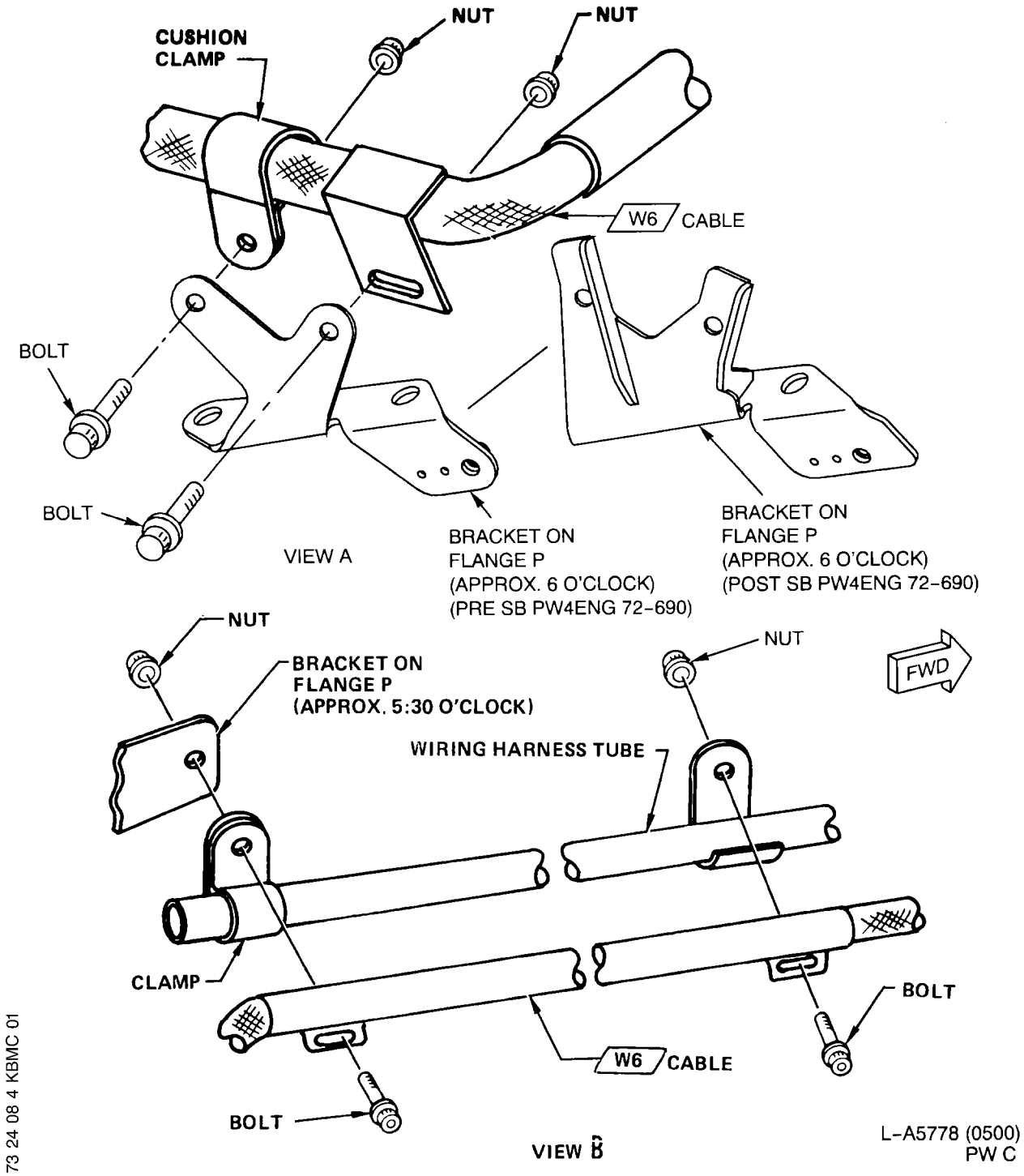
FADEC Thermocouple and Airframe Cable (W6) Sheet 1/17
(Post SB PW4ENG 73-163)
Figure 404



L-B2653 (0000)

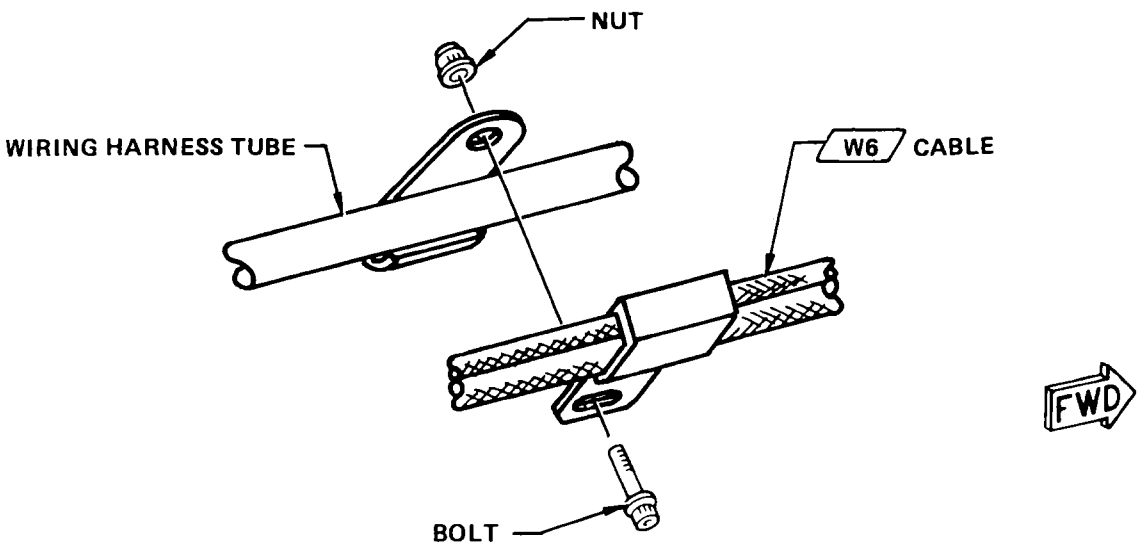
BM5 73 24 08 4 KBMB 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 2/17
(Post SB PW4ENG 73-163)
Figure 404

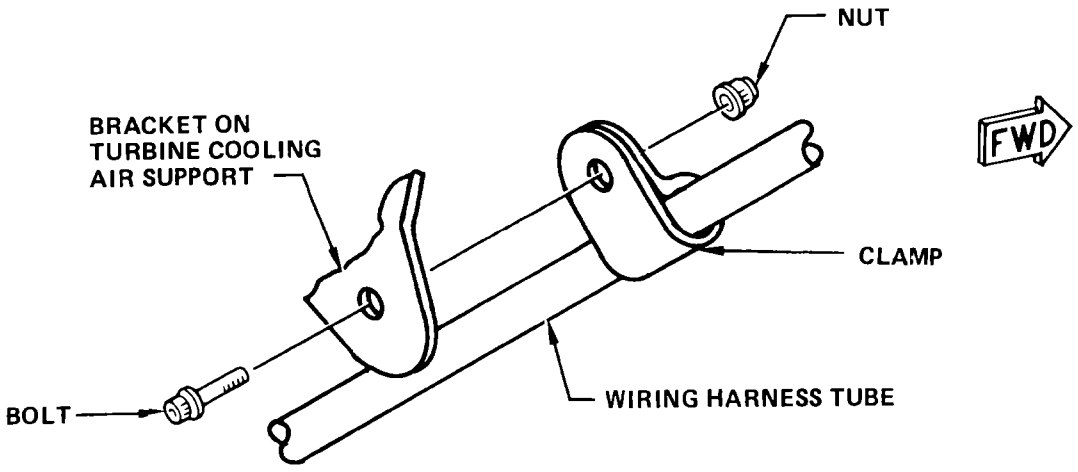


BM5 73 24 08 4 KBMC 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 3/17
(Pre and Post SB PW4ENG 73-163)
Figure 404



VIEW C

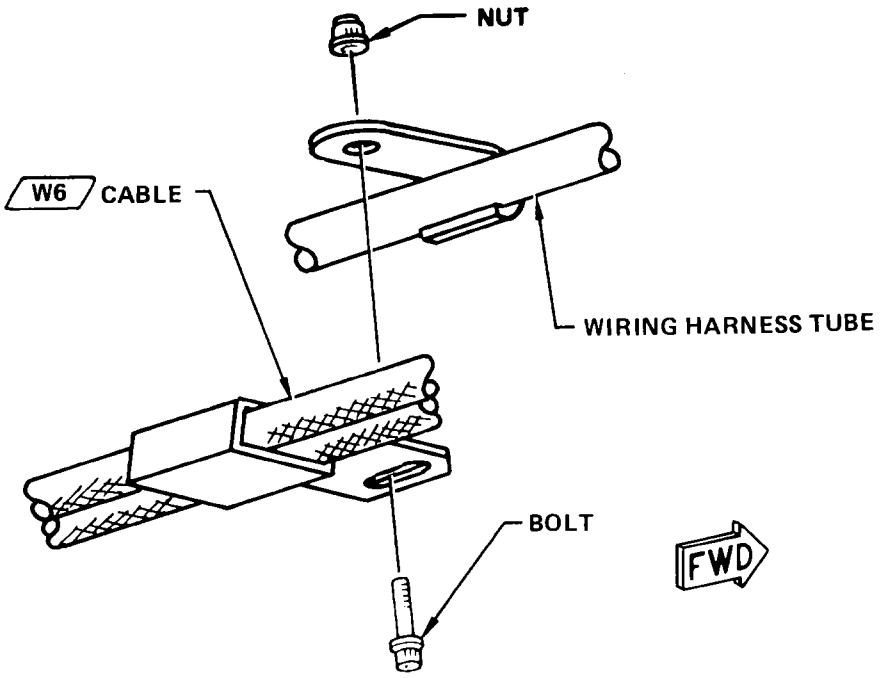


VIEW D

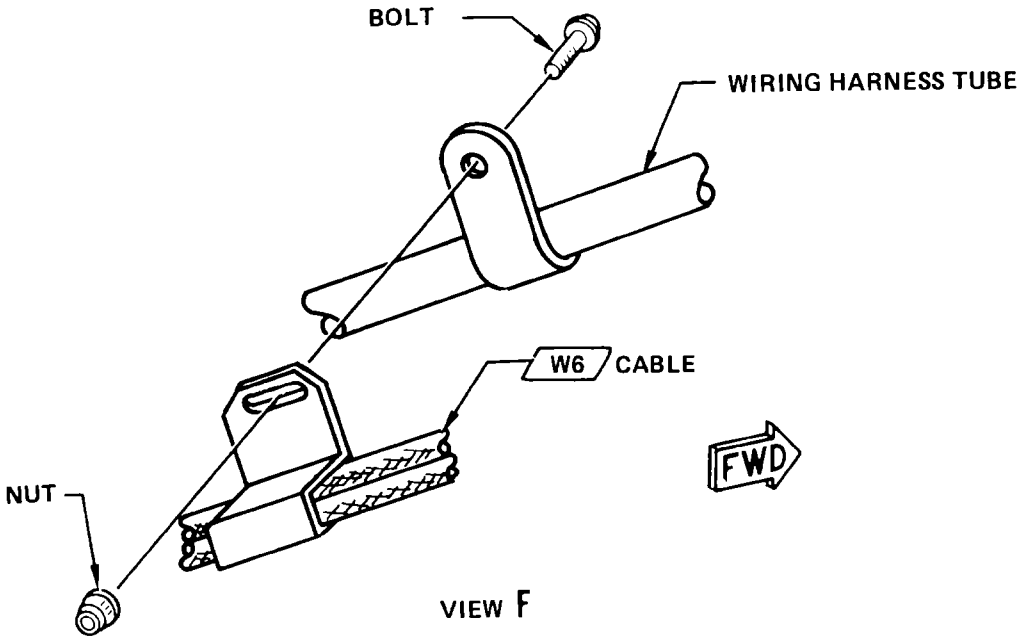
L-A5779

BM5 73 24 08 4 KBMD 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 4/17
(Pre and Post SB PW4ENG 73-163)
Figure 404



VIEW E

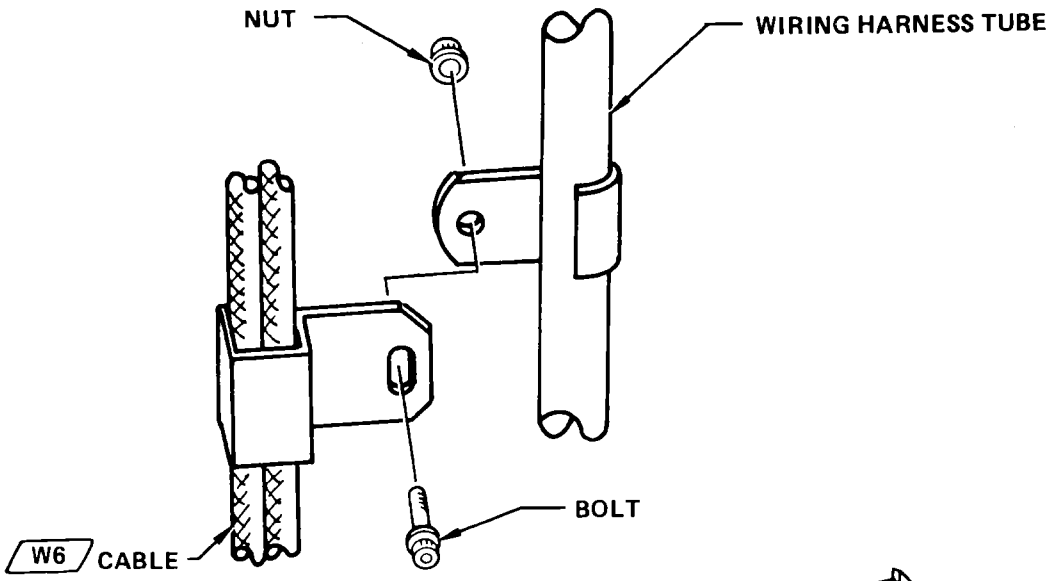


VIEW F

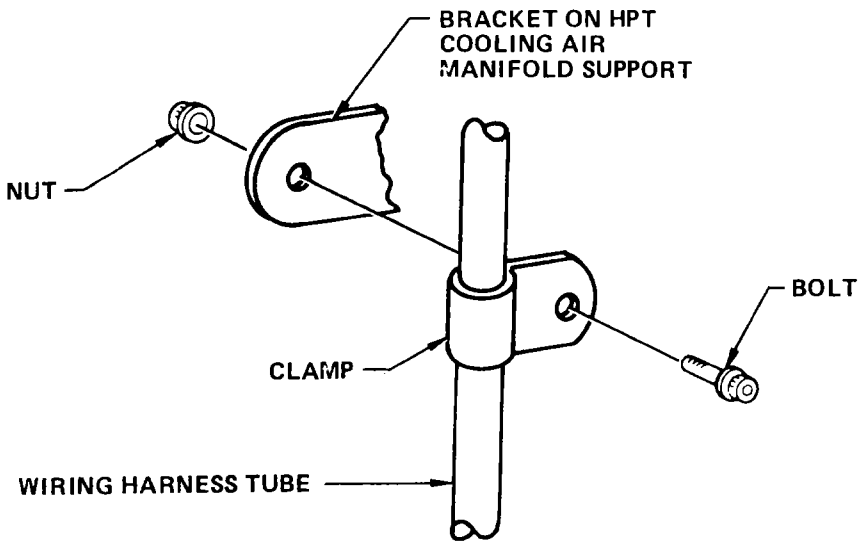
L-A5780

BM5 73 24 08 4 KBME 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 5/17
(Pre and Post SB PW4ENG 73-163)
Figure 404



VIEW G

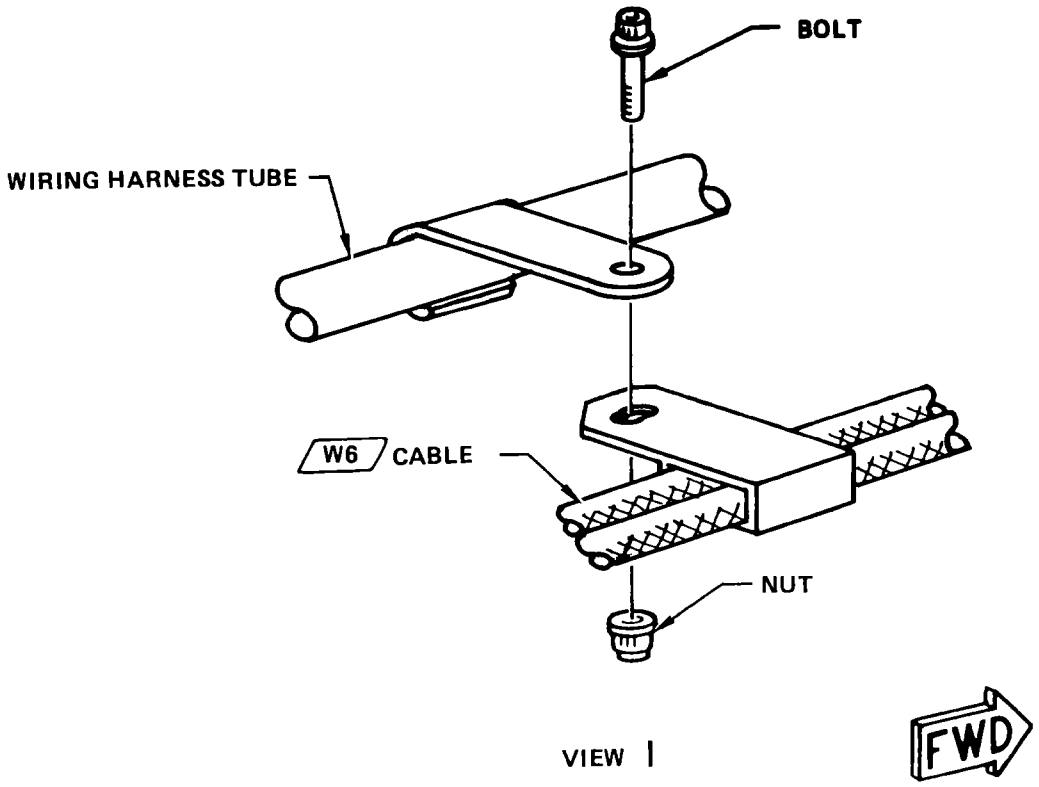


VIEW H

L-A5781

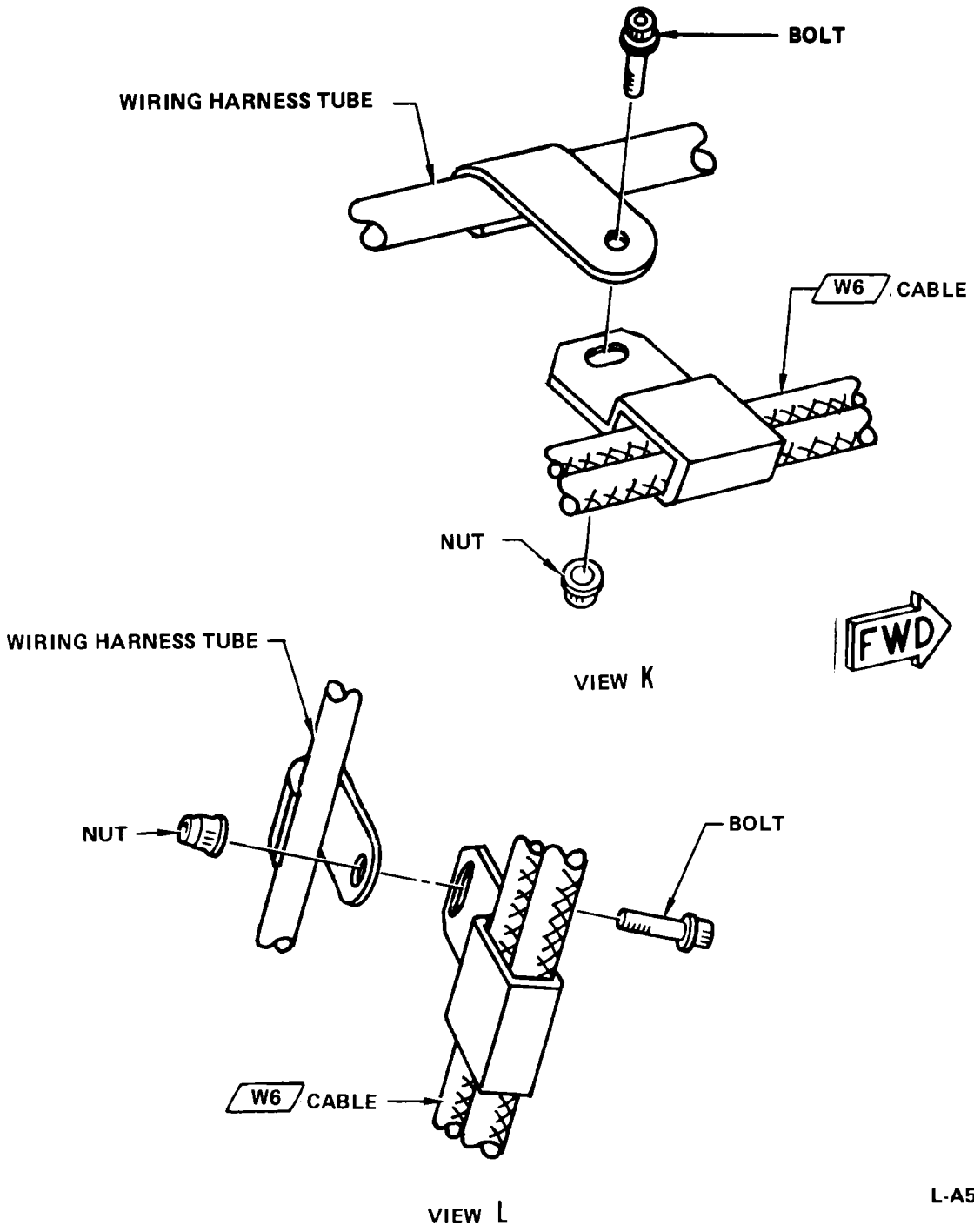
BM5 73 24 08 4 KBMF 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 6/17
(Pre and Post SB PW4ENG 73-163)
Figure 404



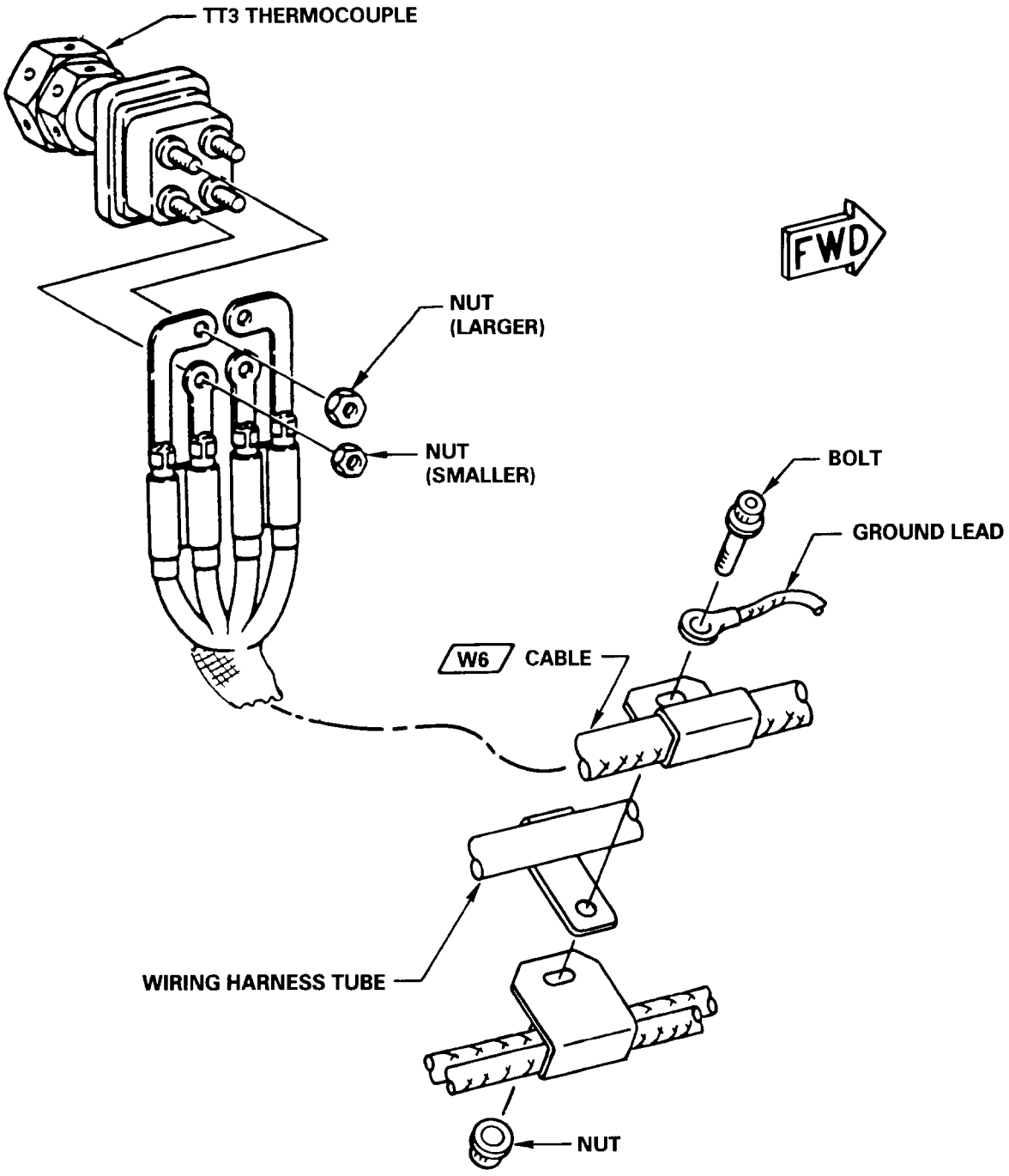
BM5 73 24 08 4 KBMG 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 7/17
(Pre and Post SB PW4ENG 73-163)
Figure 404



BM5 73 24 08 4 KBMH 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 8/17
(Pre and Post SB PW4ENG 73-163)
Figure 404

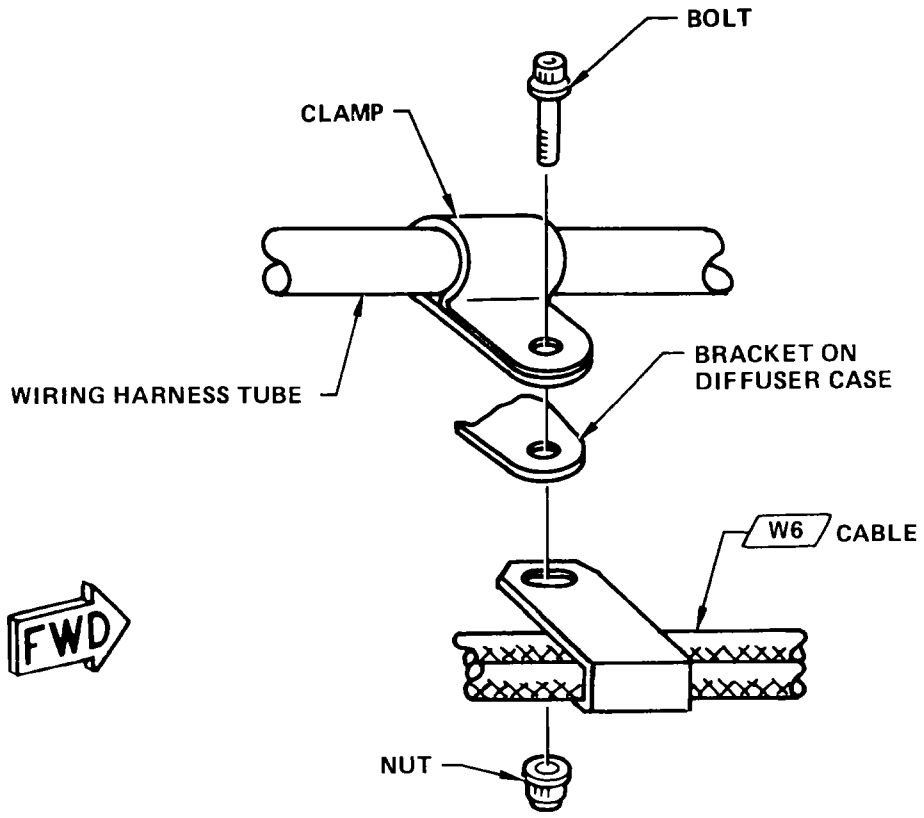


VIEW M

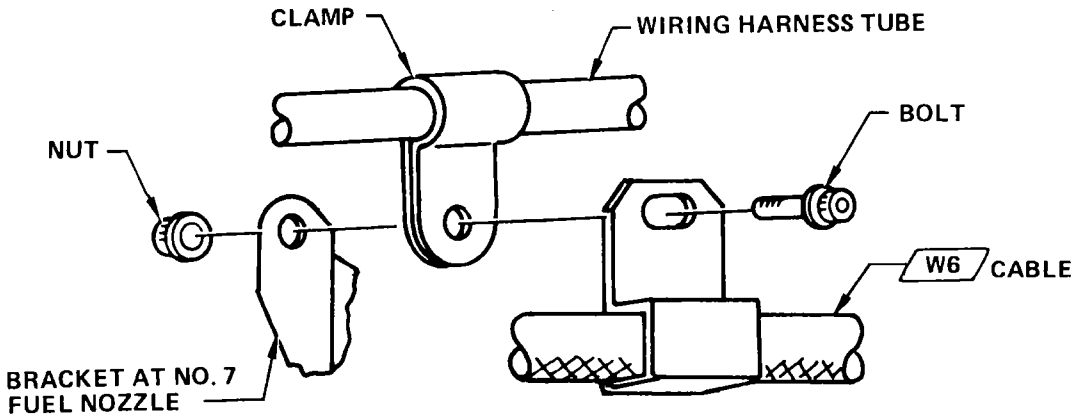
L-A5784(0000)

BM5 73 24 08 4 KBMJ 01

FADEC Thermocouple and Airframe Cable (W6) Sheet 9/17
(Pre SB PW4ENG 73-163)
Figure 404



VIEW N

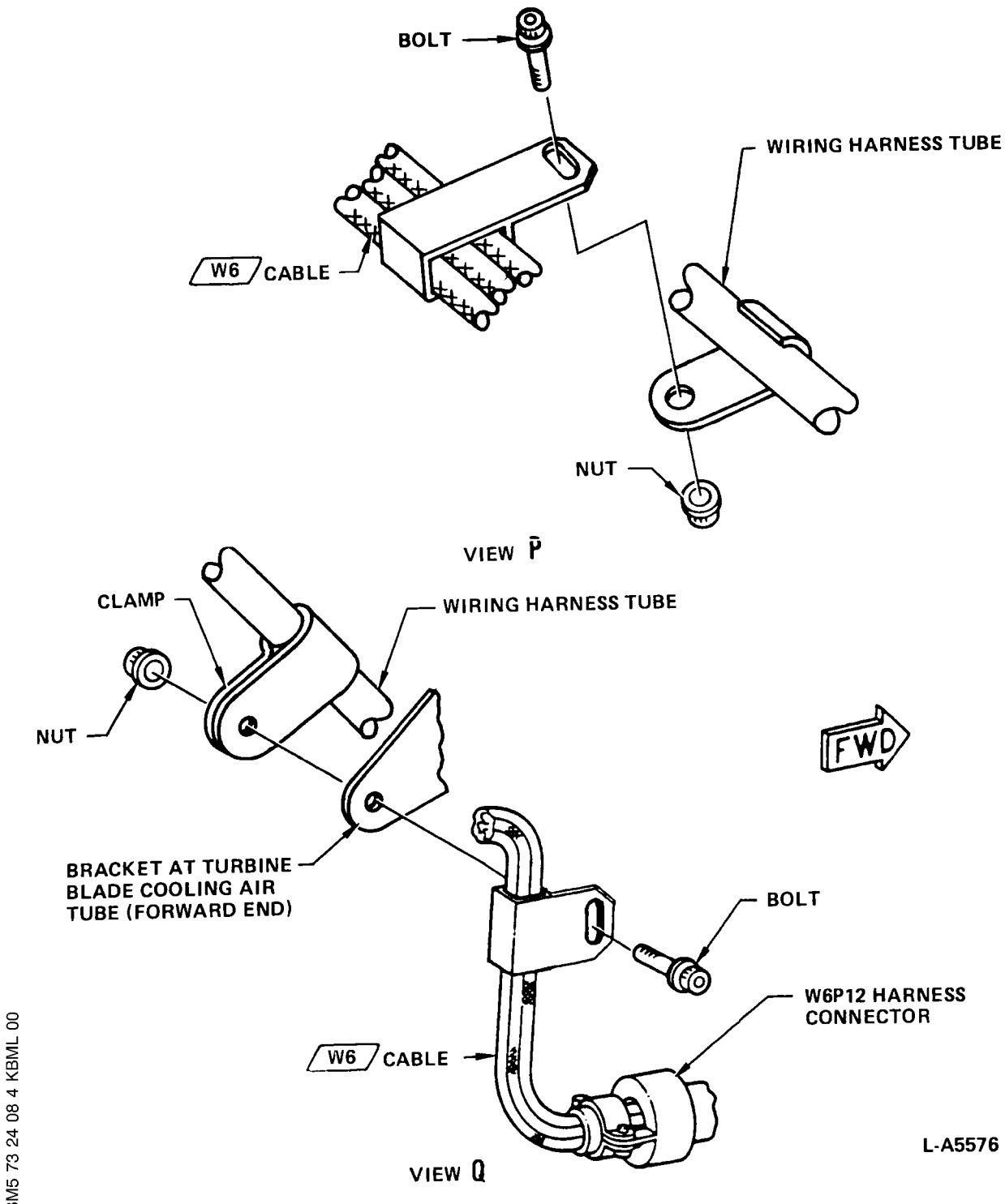


L-A5575

VIEW Ũ

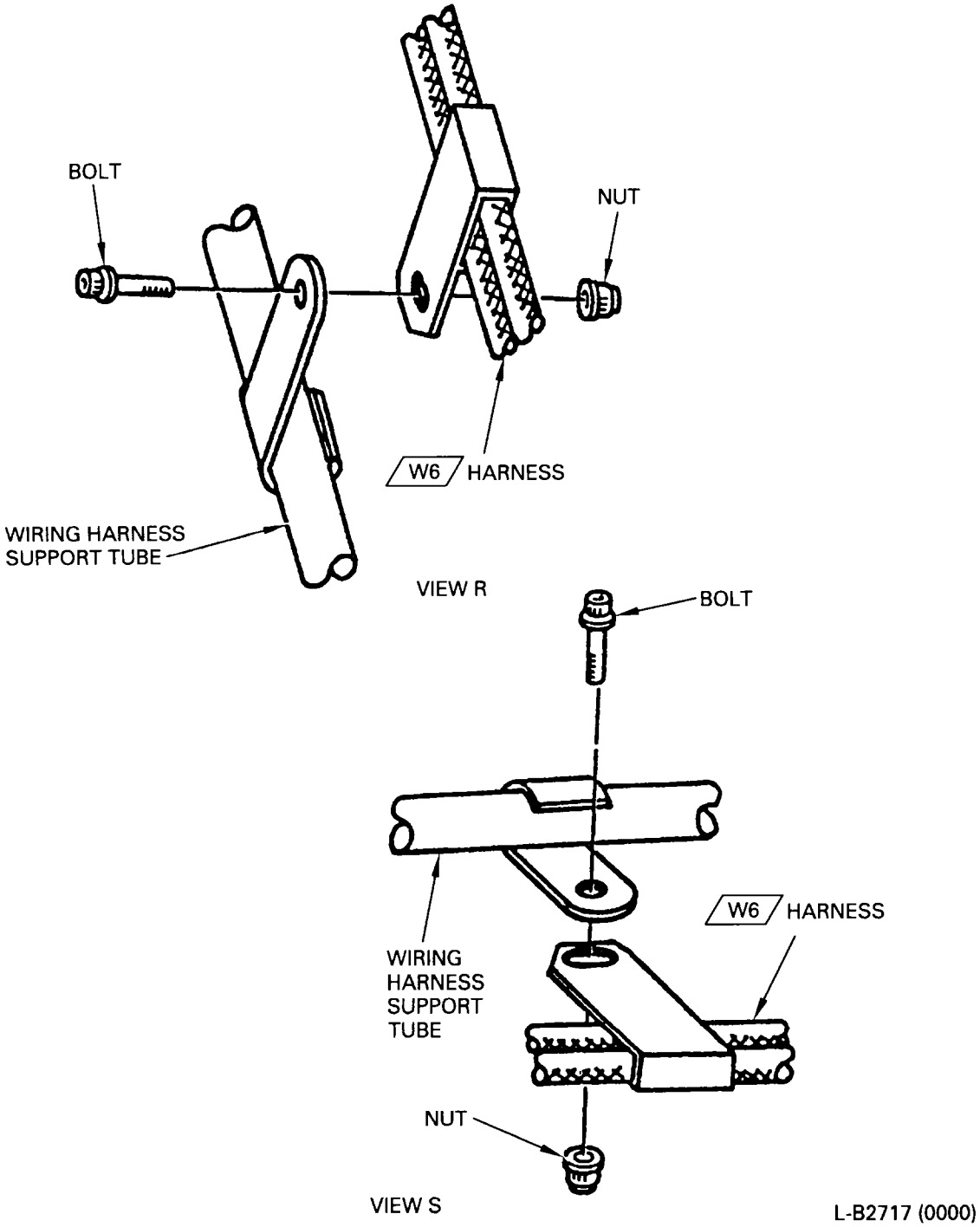
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FADEC Thermocouple and Airframe Cable (W6) Sheet 10/17
(Pre SB PW4ENG 73-163)
Figure 404



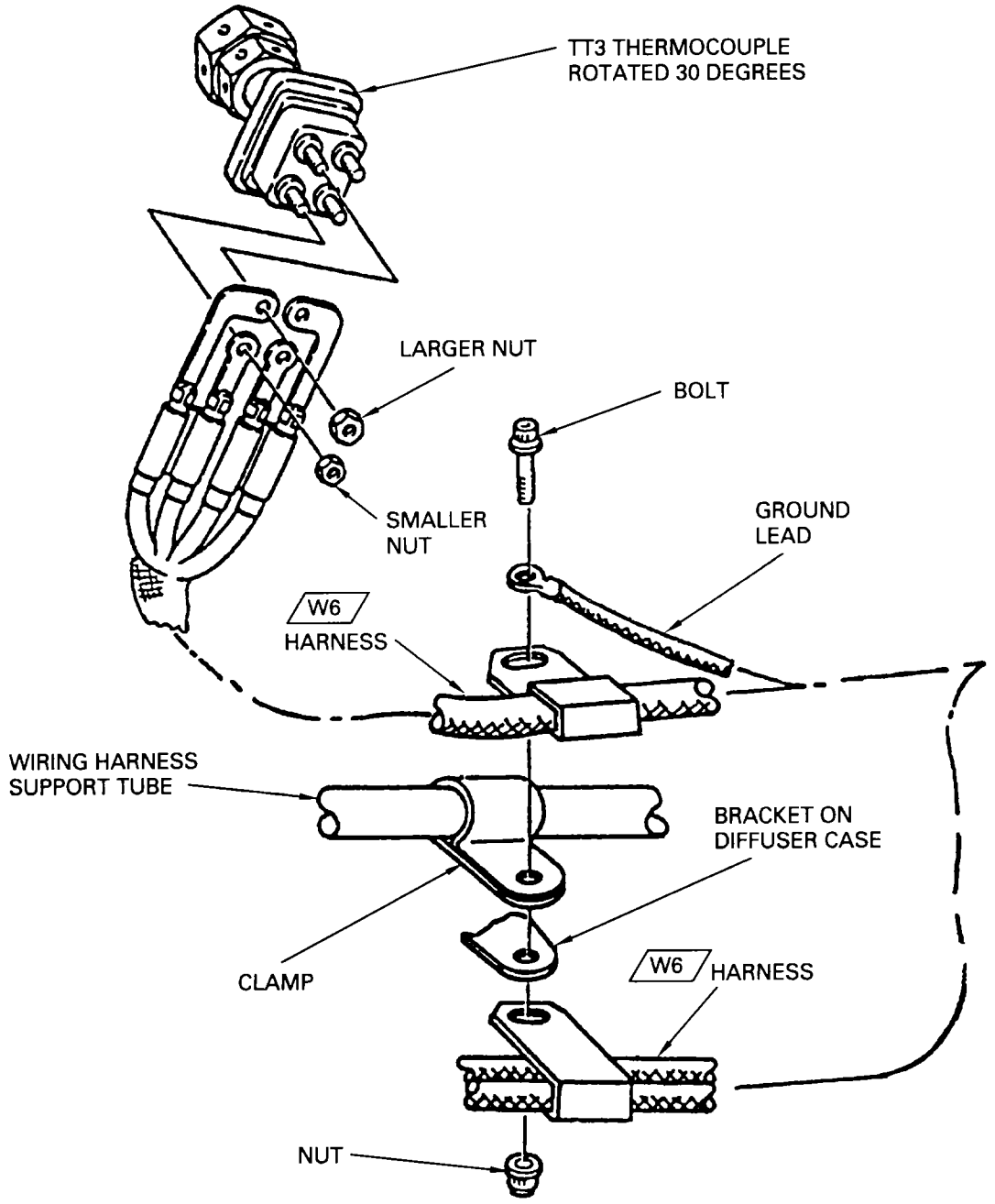
BM5 73 24 08 4 KBML 00

FADEC Thermocouple and Airframe Cable (W6) Sheet 11/17
(Pre SB PW4ENG 73-163)
Figure 404



BM5 73 24 08 4 KBMM 00

FADEC Thermocouple and Airframe Cable (W6) Sheet 12/17
(Post SB PW4ENG 73-163)
Figure 404

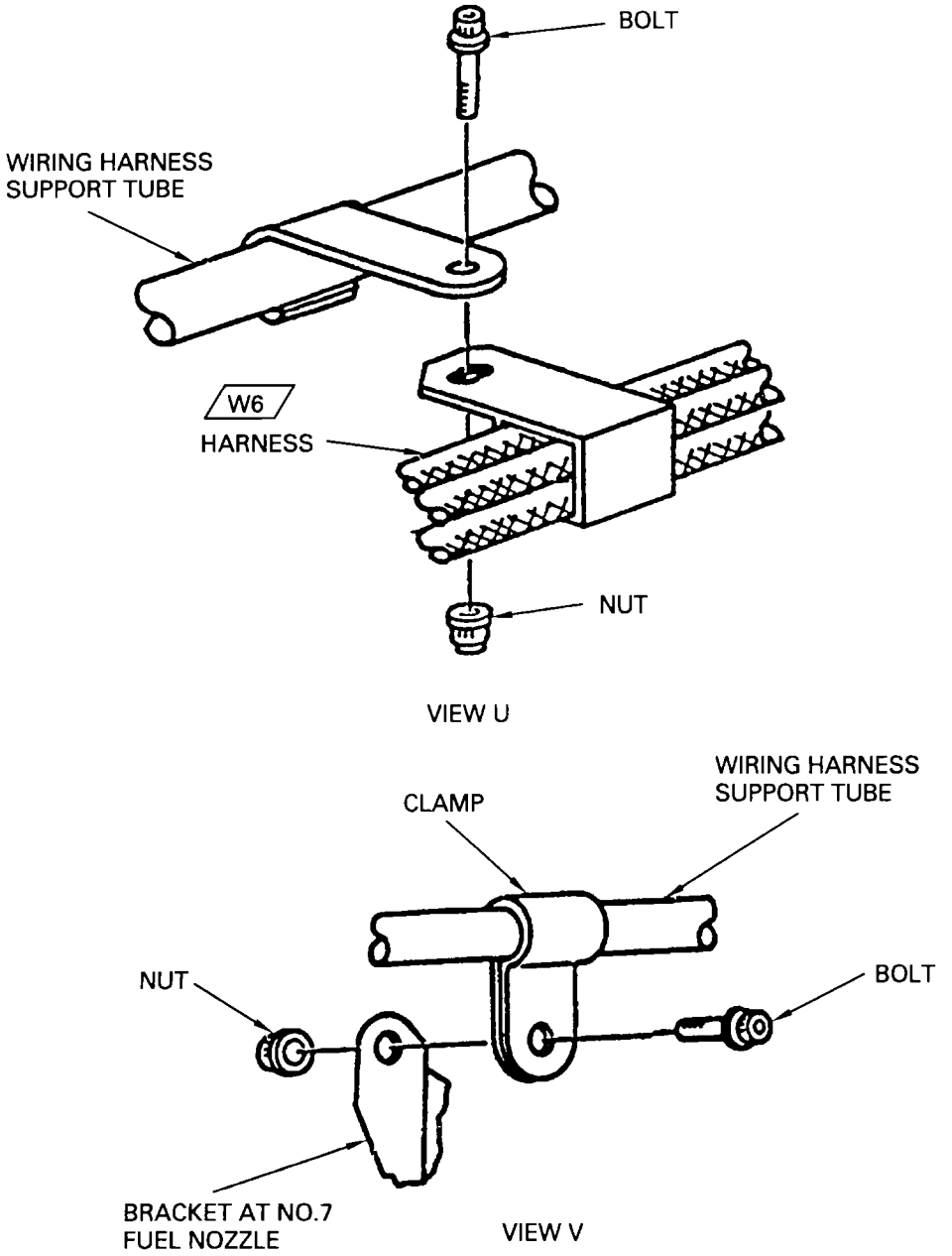


VIEW T

L-B2655 (0000)

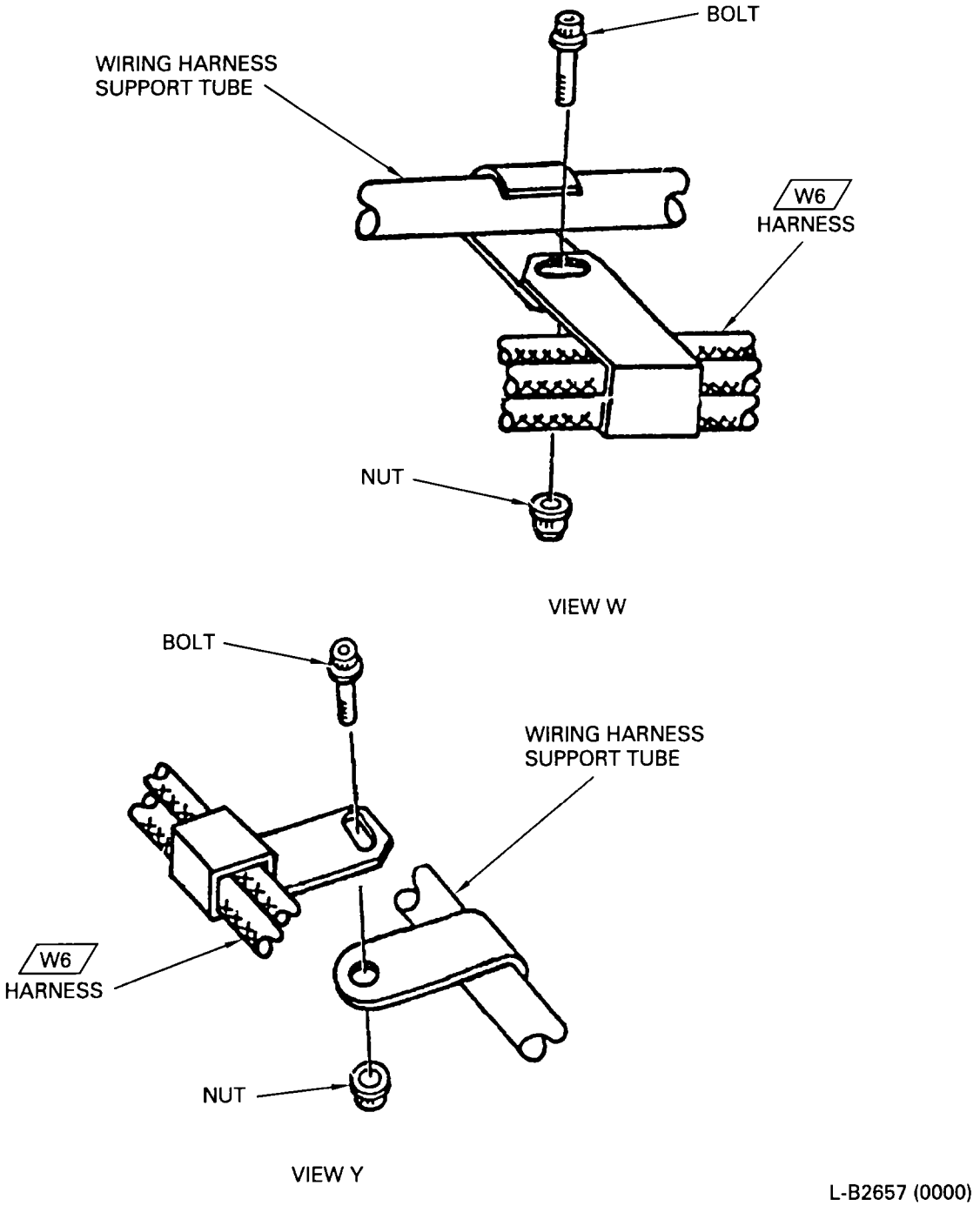
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FADEC Thermocouple and Airframe Cable (W6) Sheet 13/17
(Post SB PW4ENG 73-163)
Figure 404



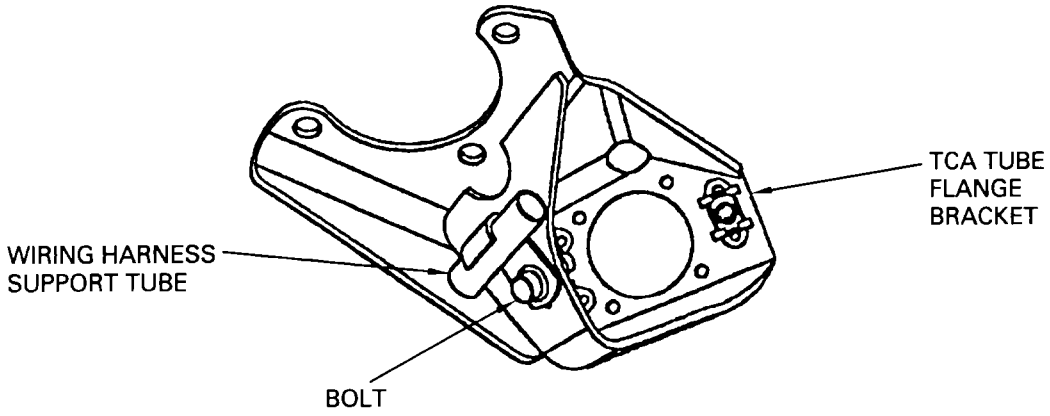
BM5 73 24 08 4 KBMP 00

FADEC Thermocouple and Airframe Cable (W6) Sheet 14/17
(Post SB PW4ENG 73-163)
Figure 404



BM5 73 24 08 4 KBMR 00

FADEC Thermocouple and Airframe Cable (W6) Sheet 15/17
(Post SB PW4ENG 73-163)
Figure 404

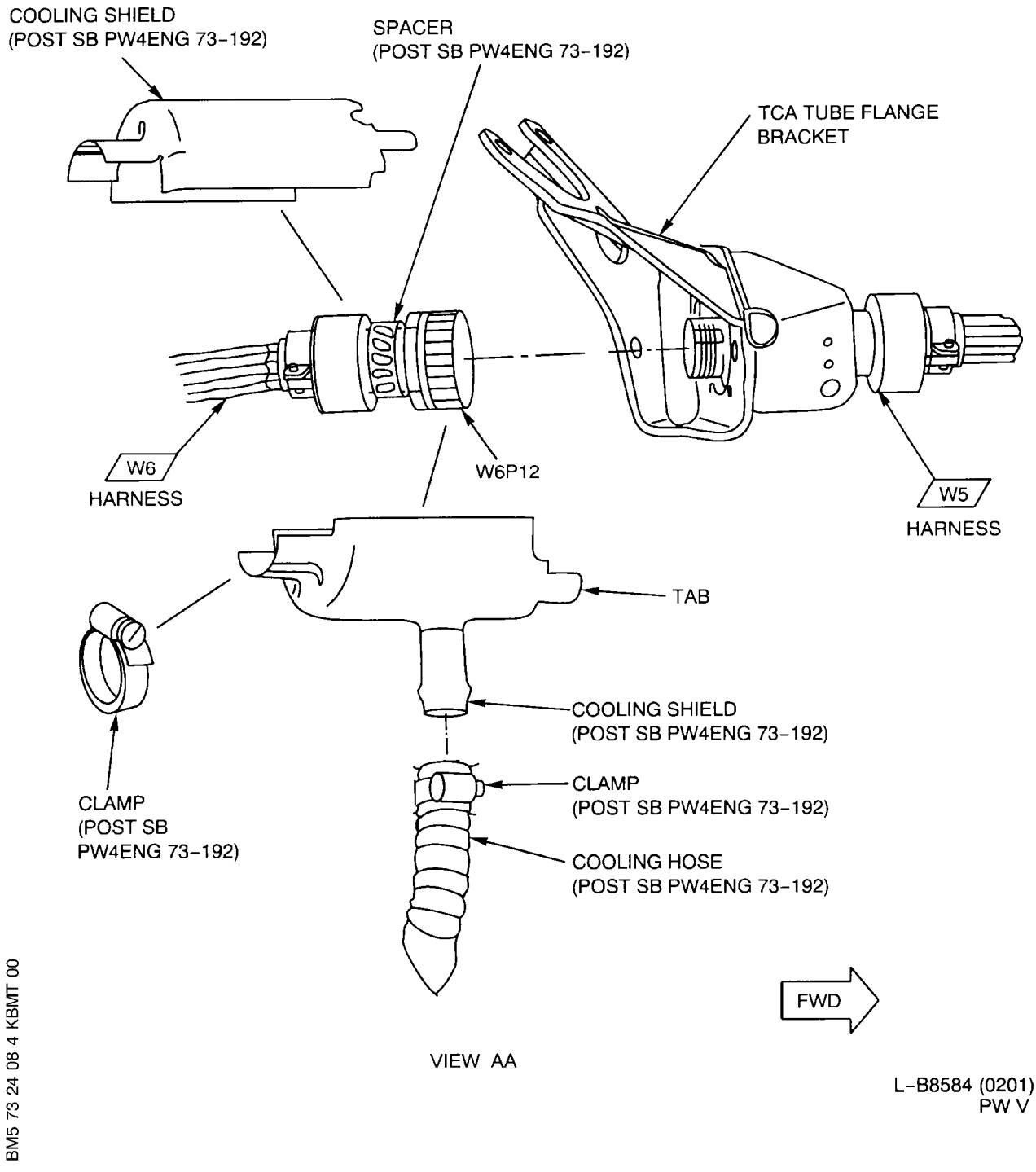


SECTION Z-Z

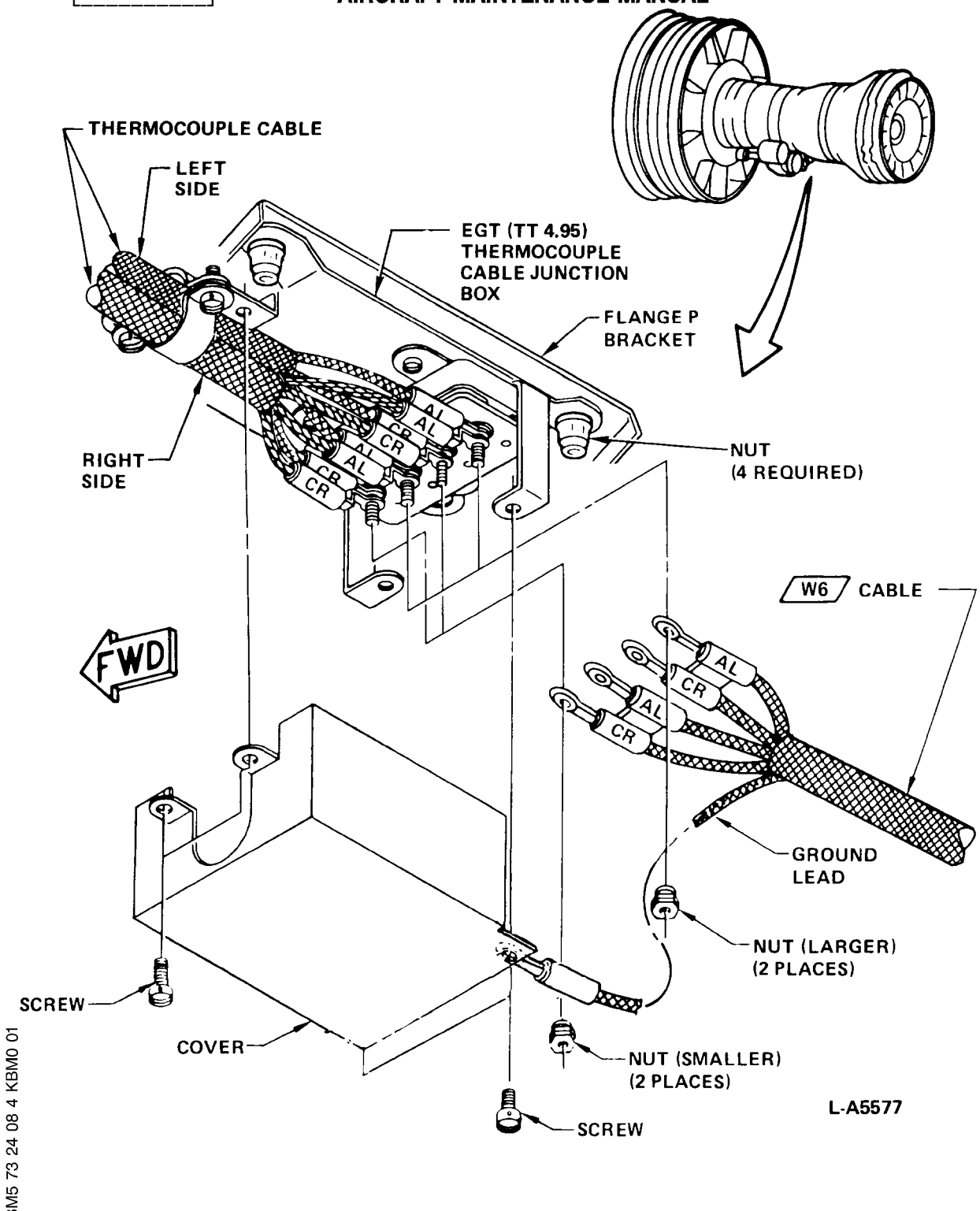
L-B2658 (0000)

BM5 73 24 08 4 KBMS 00

FADEC Thermocouple and Airframe Cable (W6) Sheet 16/17
(Post SB PW4ENG 73-163)
Figure 404



FADEC Thermocouple and Airframe Cable (W6) Sheet 17/17
(Post SB PW4ENG 73-163)
Figure 404



FADEC Thermocouple and Airframe Cable (W6)
Figure 405

4. FADEC Core Engine Electrical Harnesses (W3)

NOTE : This procedure provides for removal/installation of FADEC core engine electrical harnesses (W3).

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.A.	19KS	332/U70
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.B.	21KS	331/V70
133VU	ENG1 - SCU SUPPLY - GND	35KS	333/T76
133VU	ENG1 - SCU SUPPLY - FLT	37KS	333/T75
Engine 2			
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.A.	18KS	332/U71
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.B.	20KS	331/V69
133VU	ENG2 - SCU SUPPLY GND	34KS	333/T85
133VU	ENG2 - SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 406, 408, 410)
(Ref. Fig. 412, 413, 414)
(Ref. Fig. 416, 418, 419)
R (Ref. Fig. 421, 422, 423)
(Ref. Fig. 424, 426)

CAUTION : AVOID TWISTING OR SEVERE BENDING OF CABLE AT ANY TIME DURING REMOVAL OR DAMAGE TO CABLE MAY RESULT.

(1)Disconnect W1P24 harness connector from W3J24 harness connector located at 10 o'clock position on HPC case.

(a)Remove two bolts and harness bracket securing W3J24 harness connector flange to bracket on HPC case. Remove connector from bracket. Install protective closure on each harness connector (Ref. Fig. 412).

(2)Disconnect the following harness connectors from the components given below. Install a protective closure on each harness connector and mating receptacle.
(Ref. Fig. 408, 410).

Connector	Component	Location
W3P5	Fuel/Oil Cooler Bypass Valve Solenoid (Forward Connector)	8 o'clock
W3P17	Air/Oil Heat Exchanger and Valve (Engine)	8 o'clock
W3P15	2.5 Bleed Valve Actuator	Intermediate Case 7:30 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W3P15 harness connector.		

Connector	Component	Location
W3P1	EEC Alternator (Upper Connector)	Bottom of Gearbox 7 o'clock
W3P12	HPC Secondary Flow Control Valve, Turbine Cooling Air Valve Solenoid	Intermediate Case 10 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W3P1 and W3P12 harness connectors.		
W3P18	EEC Oil Temperature Thermocouple Probe	Front of Gearbox 7 o'clock

(3)Remove the bolts, nuts, and clamps that attach the W3 harness to the brackets, support tubes and thermocouple on the HPC case and the gearbox
(Ref. Fig. 412, 413, 414)
(Ref. Fig. 416, 418, 419)
(Ref. Fig. 421, 422, 423).
(4)Remove the applicable harness ties and carefully remove the W3 harness.
(5)Install protective closures.

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

B. Removal (Ref. Fig. 407, 409, 411)
(Ref. Fig. 412, 413, 415)
(Ref. Fig. 417, 420, 421)
(Ref. Fig. 422, 423, 427)
CAUTION : AVOID TWISTING OR SEVERE BENDING OF CABLE AT ANY TIME DURING REMOVAL OR DAMAGE TO CABLE MAY RESULT.
(1)Disconnect W1P24 harness connector from W3J24 harness connector located at 10 o'clock position on HPC case.
(a)Remove two bolts and harness bracket securing W3J24 harness connector flange to bracket on HPC case. Remove connector from bracket. Install protective closure on each harness connector (Ref. Fig. 412).
(2)Disconnect the following harness connectors from the components given below. Install a protective closure on each harness connector and mating receptacle.
(Ref. Fig. 409, 411).

Connector	Component	Location
W3P5	Fuel/Oil Cooler Bypass Valve Solenoid (Forward Connector)	8 o'clock

Connector	Component	Location
W3P17	Air/Oil Heat Exchanger and Valve (Engine)	8 o'clock
W3P15	2.5 Bleed Valve Actuator	Intermediate Case 7:30 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W3P15 harness connector.		
W3P1	EEC Alternator (Upper Connector)	Bottom of Gearbox 7 o'clock
W3P12	Turbine Vane Cooling Air Valve, Turbine Vane and Blade Cooling Air Valve Solenoid	Intermediate Case 10 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W3P1 and W3P12 harness connectors.		
W3P18	EEC Oil Temperature Thermocouple Probe	Front of Gearbox 7 o'clock

(3)Remove the bolts, nuts, and clamps that attach the W3 harness to the brackets, support tubes and thermocouple on the HPC case and the gearbox. (Ref. Fig. 412) through.

R (Ref. Fig. 423)

(4)Remove the applicable harness ties and carefully remove the W3 harness.

(5)Install protective closures.

**ON A/C 101-200,

C. Installation

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Install the W3 harness on the left side of the engine.

(a)Remove the protective closure. Install the W3J24 connector flange to the HPC case bracket located at the 10 o'clock position. Install the harness bracket that attaches the connector flange to the bracket. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(2)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below (Ref. 70-00-00, P. Block 201).
(Ref. Fig. 408, 410) for the connector to component locations.

Connector	Component	Location
W1P24	Harness Connector to W3J24 Harness Connector	10:00 o'clock
W3P12	HPC Secondary Flow Control Valve, Turbine Cooling Air Valve Solenoid	Intermediate Case 10:00 o'clock
W3P17	Air/Oil Heat Exchanger and Valve (Engine)	8:00 o'clock
W3P15	2.5 Bleed Valve Actuator	Intermediate Case 7:30 o'clock
W3P5	Fuel/Oil Cooler Bypass Valve Solenoid (Forward Connector)	8:00 o'clock
W3P1	EEC alternator (Upper Connector)	Bottom of Gearbox 7:00 o'clock
W3P18	EEC Oil Temperature Thermocouple Probe (Pre SB PW4ENG 73-84)	Front of Gearbox 7:00 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W3P12, W3P15, and the W3P1 connectors.		

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

C. Installation

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Install the W3 harness on the left side of the engine.

(a)Remove the protective closure. Install the W3J24 connector flange to the HPC case bracket located at the 10 o'clock position. Install the harness bracket that attaches the connector flange to the bracket. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS

CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(2)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below (Ref. 70-00-00, P. Block 201).
(Ref. Fig. 409, 411) for the connector to component locations.

R	Connector	Component	Location
	W1P24	Harness Connector to W3J24 Harness Connector	10:00 o'clock
	W3P12	Turbine Vane Cooling Air Valve, Turbine Vane and Blade Cooling Air Valve Solenoid	Intermediate Case 10:00 o'clock
	W3P17	Air/Oil Heat Exchanger and Valve (Engine)	8:00 o'clock
	W3P15	2.5 Bleed Valve Actuator	Intermediate Case 7:30 o'clock
	W3P5	Fuel/Oil Cooler Bypass Valve Solenoid (Forward Connector)	8:00 o'clock
	W3P1	EEC alternator (Upper Connector)	Bottom of Gearbox 7:00 o'clock
	W3P18	EEC Oil Temperature Thermocouple Probe (Pre SB PW4ENG 73-84)	Front of Gearbox 7:00 o'clock
	NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W3P12, W3P15, and the W3P1 connectors.		

**ON A/C 101-200,

(3)(POST SB PW4ENG 73-84), For thermocouple probes (EEC Oil Temperature and 2.95 Bleed Valve) with a studded terminal type receptacle install the wiring harness as follows.
(a)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.
(b)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.
CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE

THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(c)If necessary to align the thermocouple stud box, remove the lockwire from the thermocouple coupling nut to the adapter and loosen the coupling nut.

(d)Align the thermocouple stud box with the wiring harness connector.

(e)Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.

(f)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(g)TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).

(h)TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(i)Install lockwire from the coupling nut to the adapter.

(j)TORQUE the bolt that attachs the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(4)Adjust the W3 harness for any necessary clearances as required. Install the clamps at all clamp points. Refer to the figures. Attach the clamps loosely to the engine with bolts and/or nuts, threads lubricated with Material No.P03-001.

NOTE : Use different clamp sizes on the harnesses to prevent harness movement when tightened.

(5)Make sure that the harnesses are not tight to the point where sharp bends are caused, and that the harnesses do not touch any engine parts or plumbing. Provide a drip loop on the leads where the wires run downward into the connector.

(6)TORQUE all the previously installed clamp nuts and/or bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(7)Tie the harnesses as shown (Ref. Fig. 424, 426).

NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown (Ref. Fig. 424, 426). The clove hitch and square knot must be tightened satisfactorily in place. The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled. Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

(7)Tie the harnesses as shown (Ref. Fig. 427, 425).

NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown (Ref. Fig. 427, 425). The clove hitch and square knot must be tightened satisfactorily in place. The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled. Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

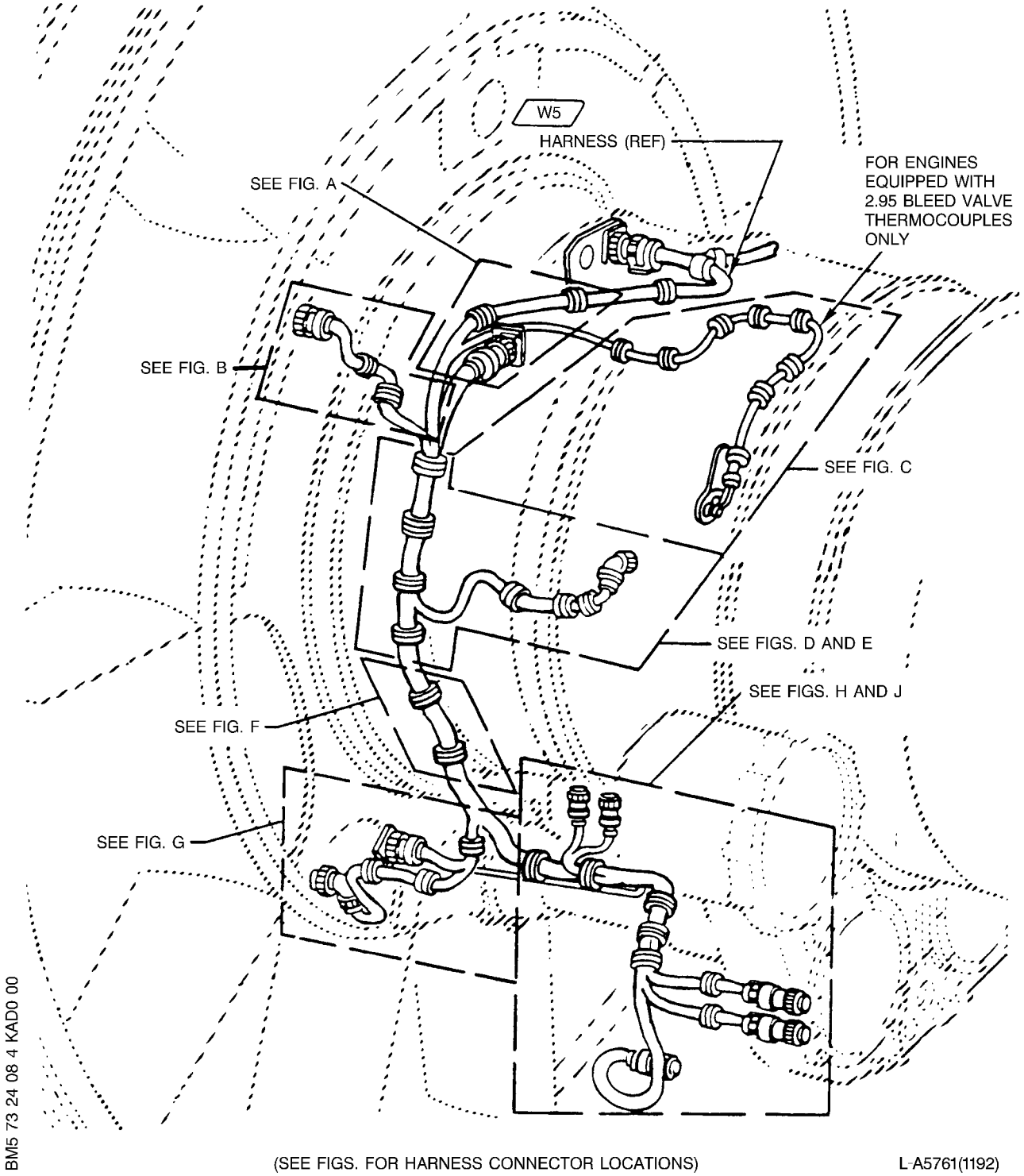
**ON A/C 101-200,

D. CLose-Up
(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(2)Remove safety clips and tags and close circuit breakers : 18KS, 19KS, 20KS, 21KS, 34KS, 35KS, 36KS, 37KS.

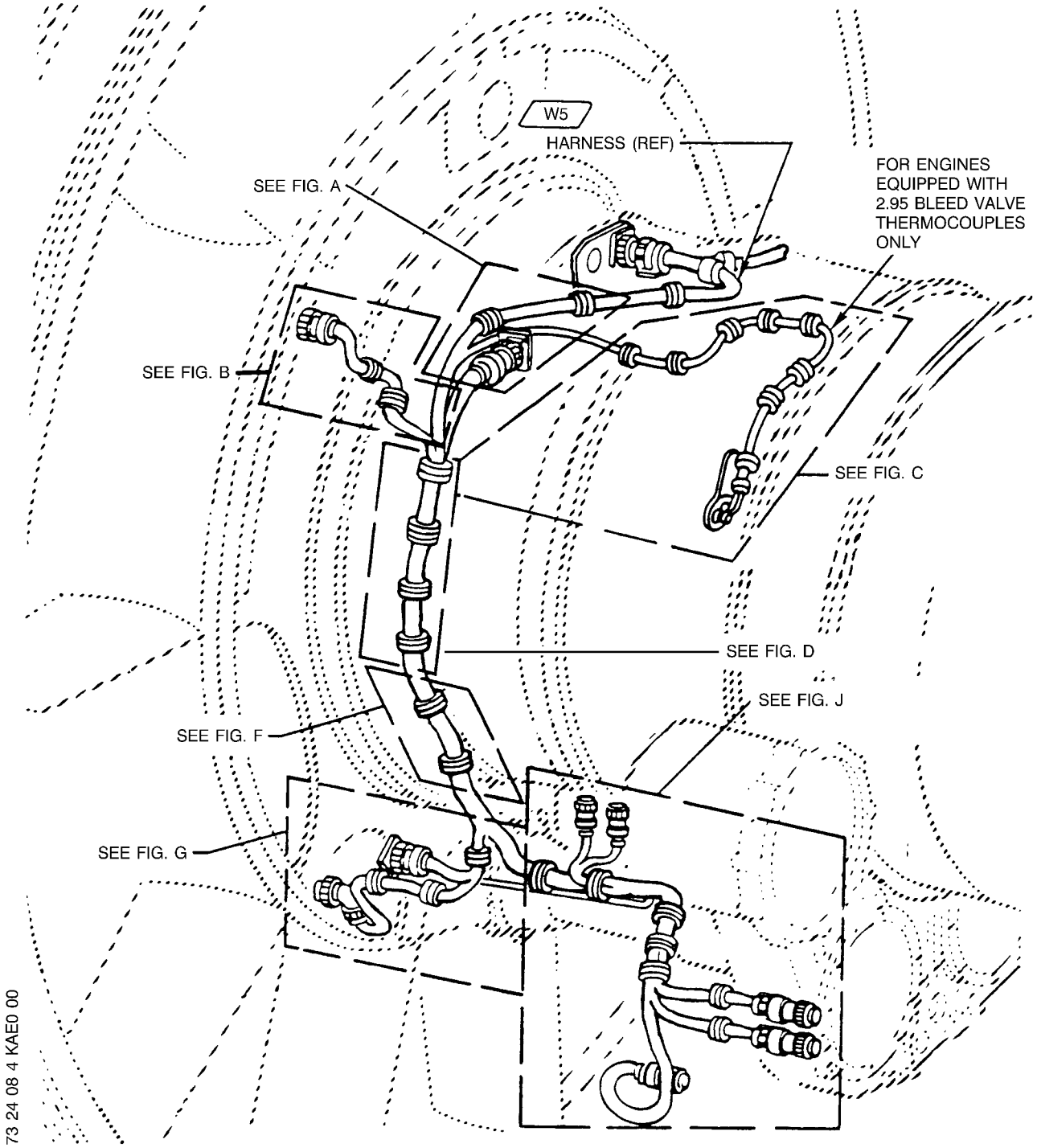
**ON A/C 101-200,

ITEM	DESIGNATION
1.	Tie
2.	The Harness Must Be Put Forward in this Location.
3.	Make a Loop in the Harness and Put the Loop Through the Clamp. Tie the Loop and the Harness Together.
4.	0.375 in. (9.525 mm) Clearance Required Between the W3P18 Connector and the Harness
5.	0.500 in. (12.700 mm) Clearance Required Between the W3P15 Connector and the Case.

Key to figure (Ref. Fig. 424)

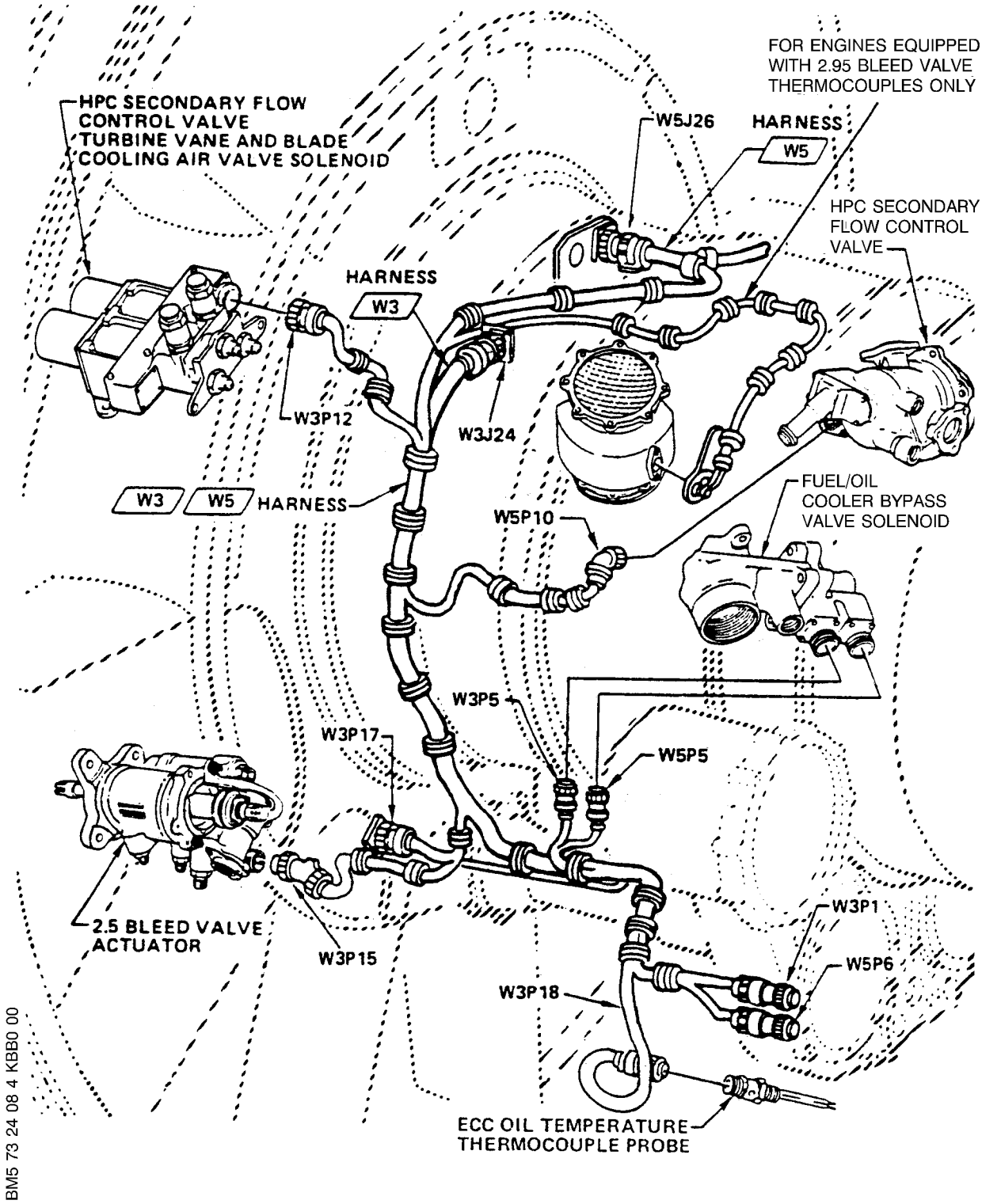


FADEC Core Engine W3 Wiring Harness
Figure 406

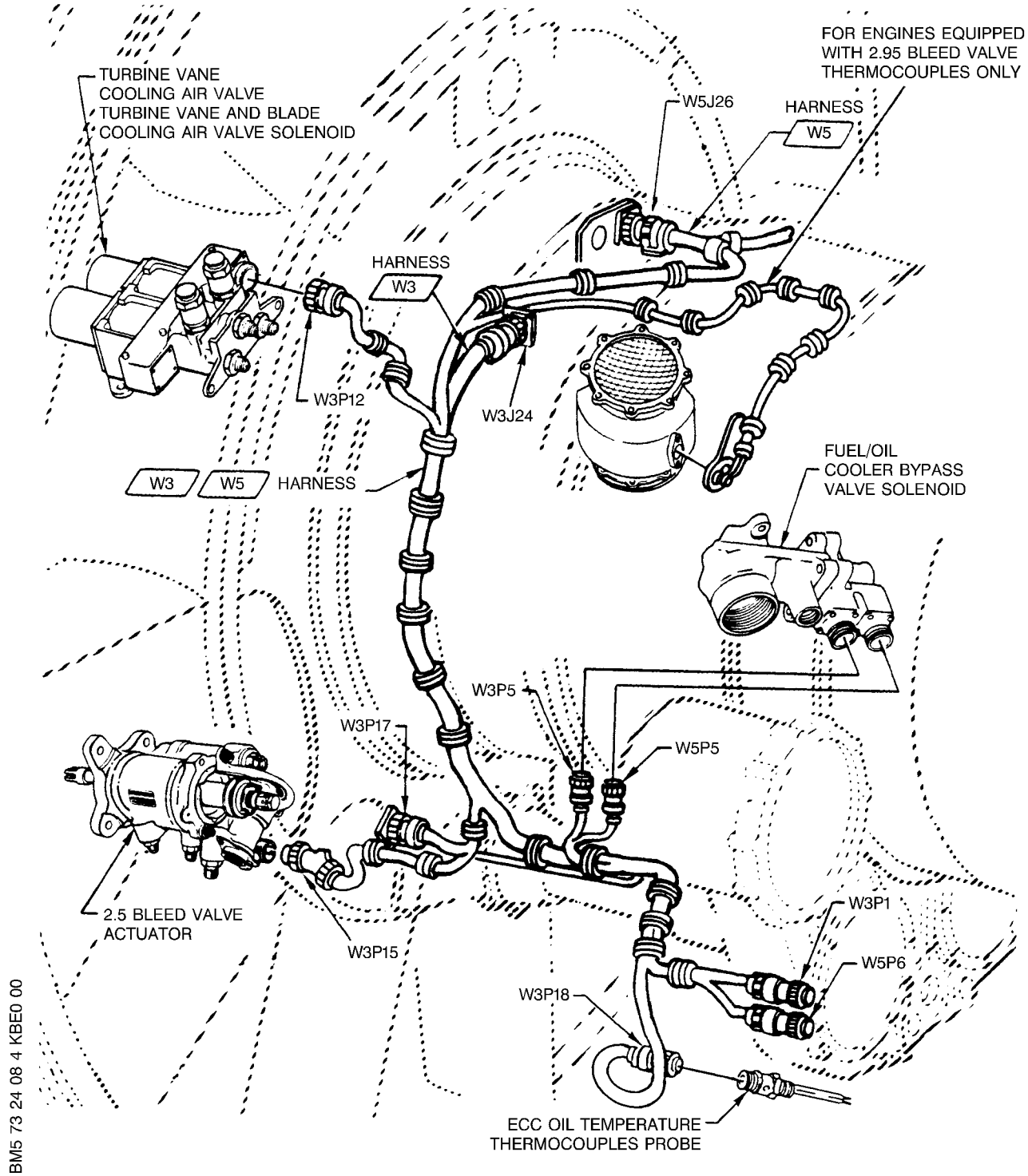


(SEE FIGS. FOR HARNESS CONNECTOR LOCATIONS)

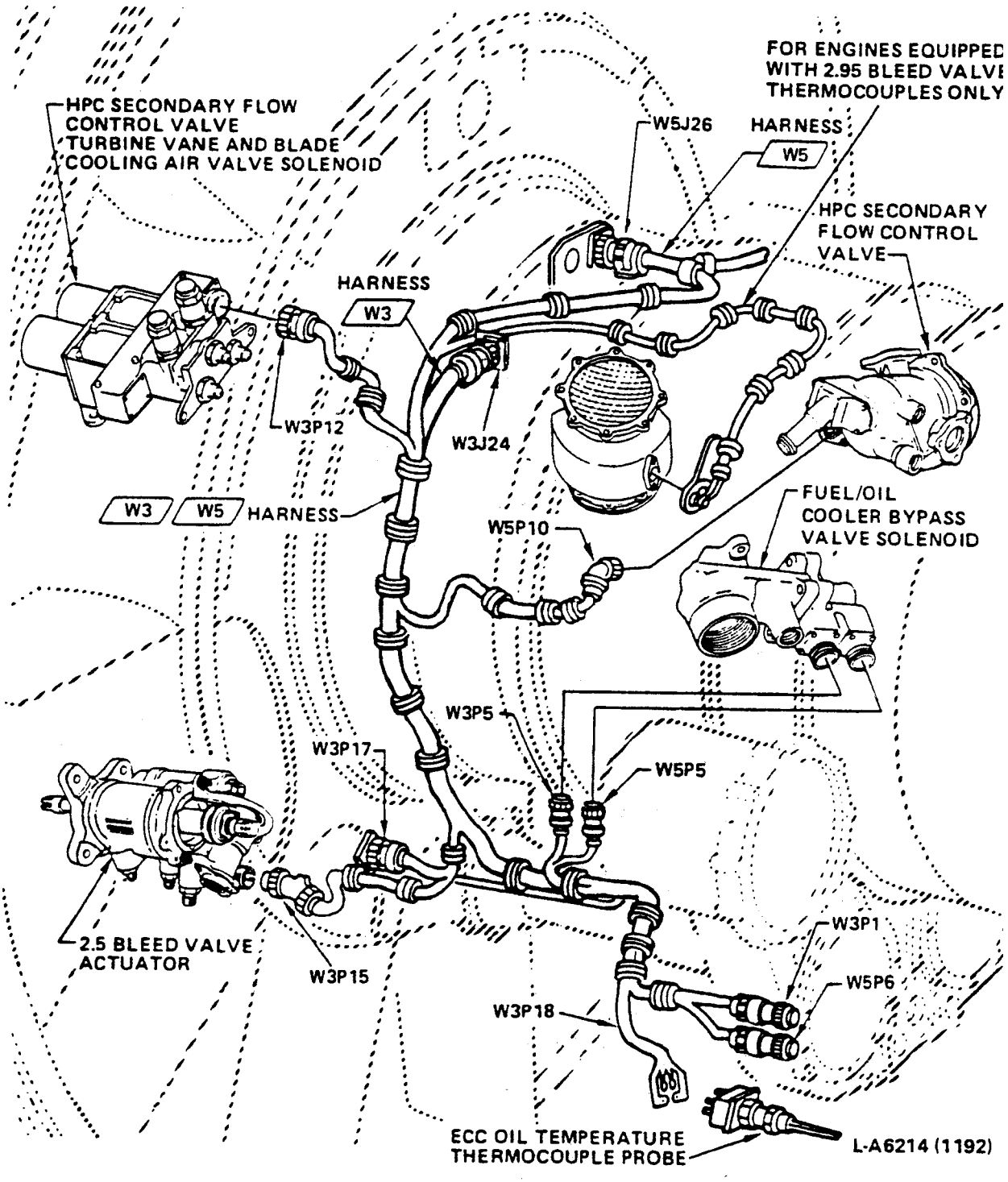
FADEC Core Engine W3 Wiring Harness
Figure 407



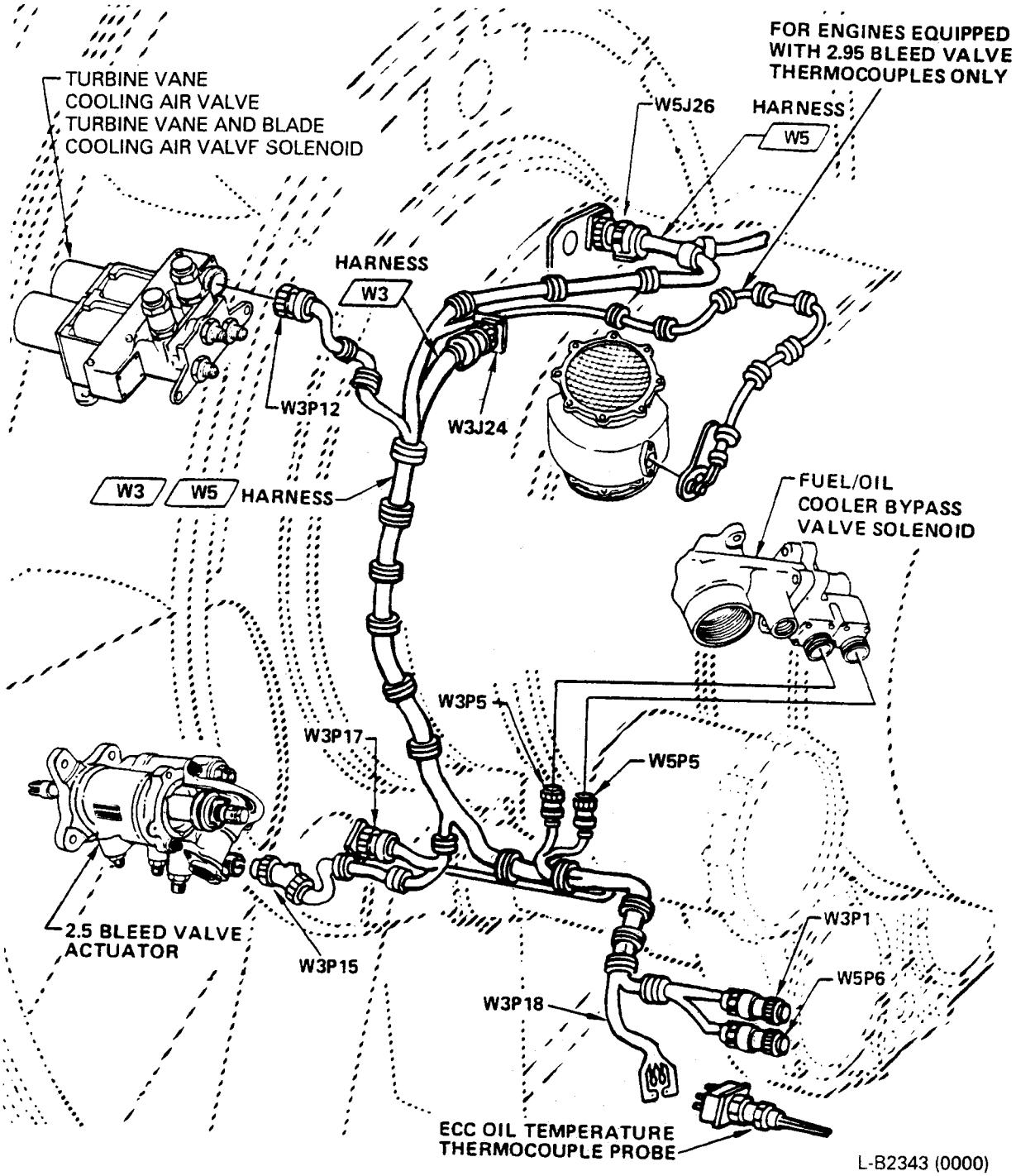
FADEC Core Engine W3 Wiring Harness - Harness Connector Locations (Pre SB PW4ENG 73-84)
Figure 408



FADEC Core Engine W3 Wiring Harness - Harness Connector Locations (Pre SB PW4ENG 73-84)
Figure 409

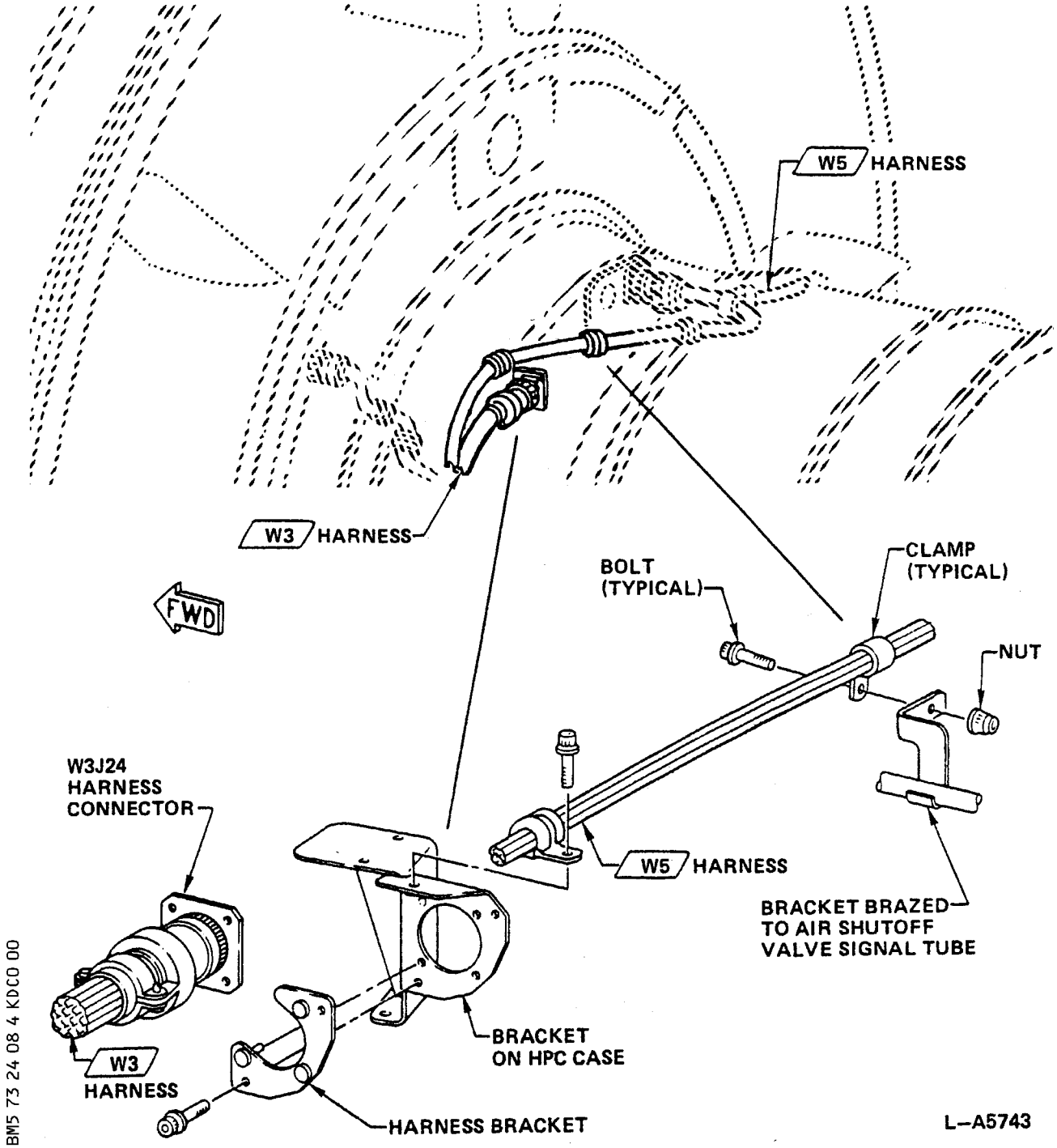


FADEC Core Engine W3 Wiring Harness - Harness Connector Locations (Post SB PW4ENG 73-84)
Figure 410

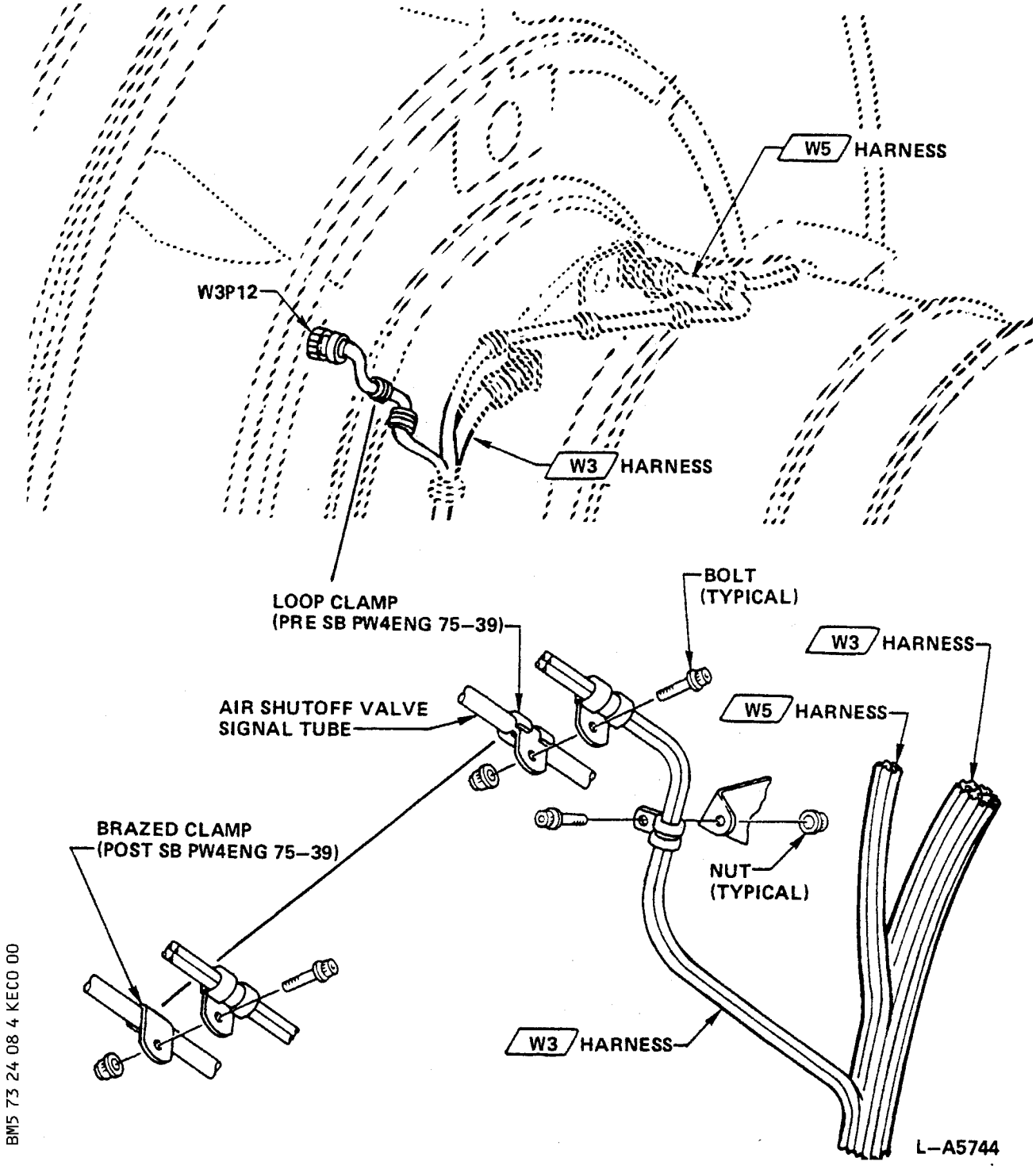


BM5 73 24 08 4 KCE0 00

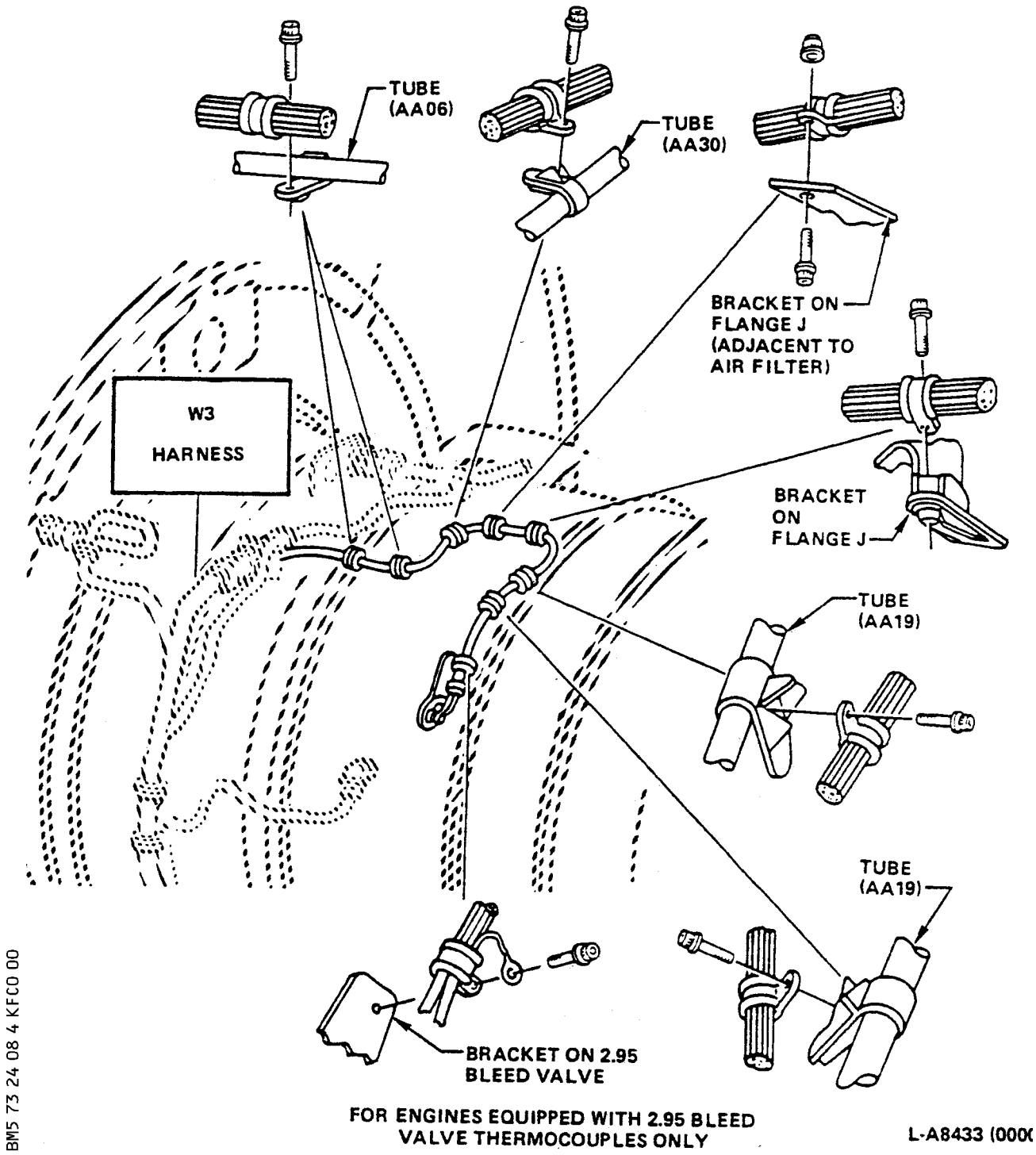
FADEC Core Engine W3 Wiring Harness - Harness Connector Locations (Post SB PW4ENG 73-84)
Figure 411



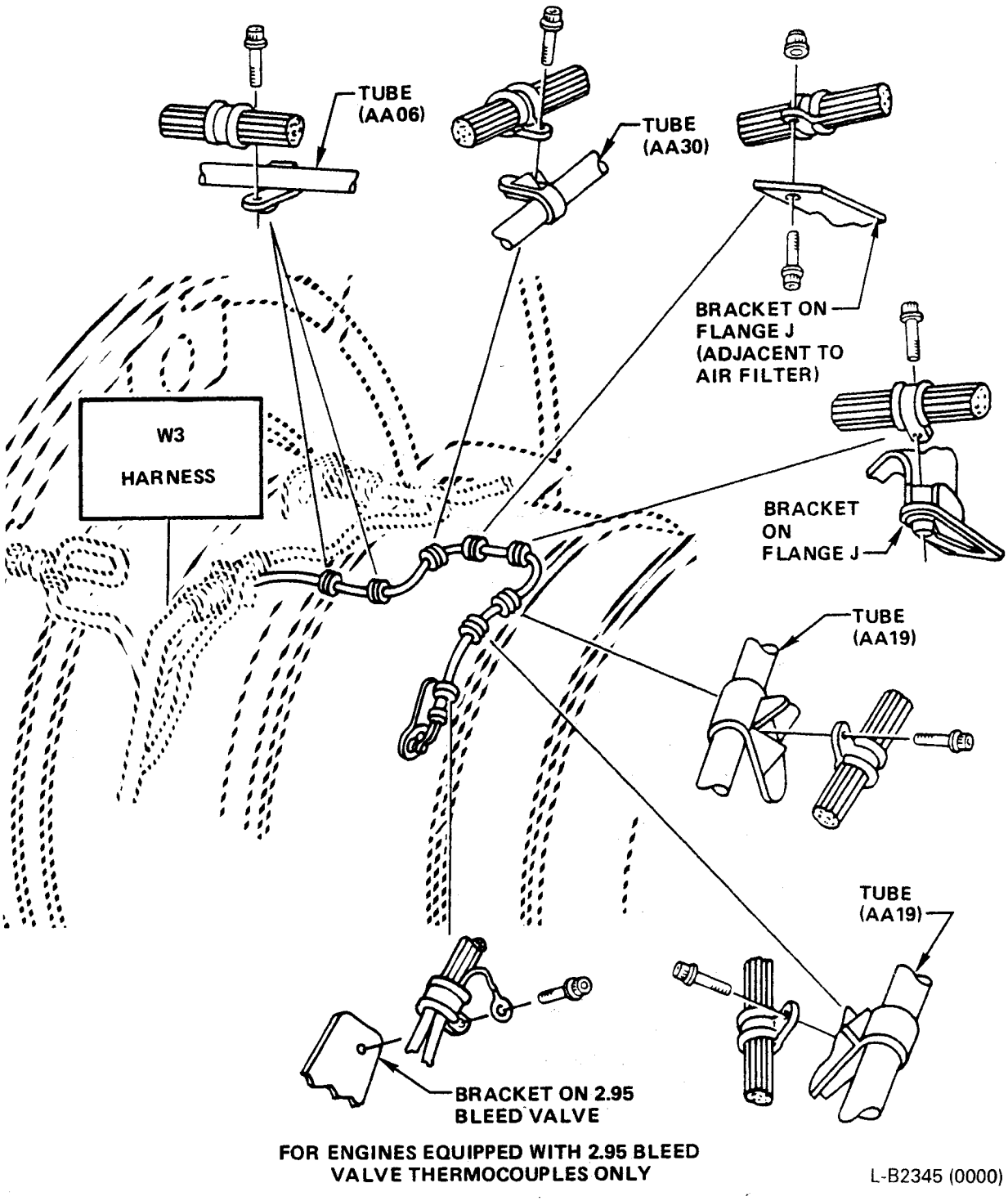
FADEC Core Engine W3 Wiring Harness - Figure A
Figure 412



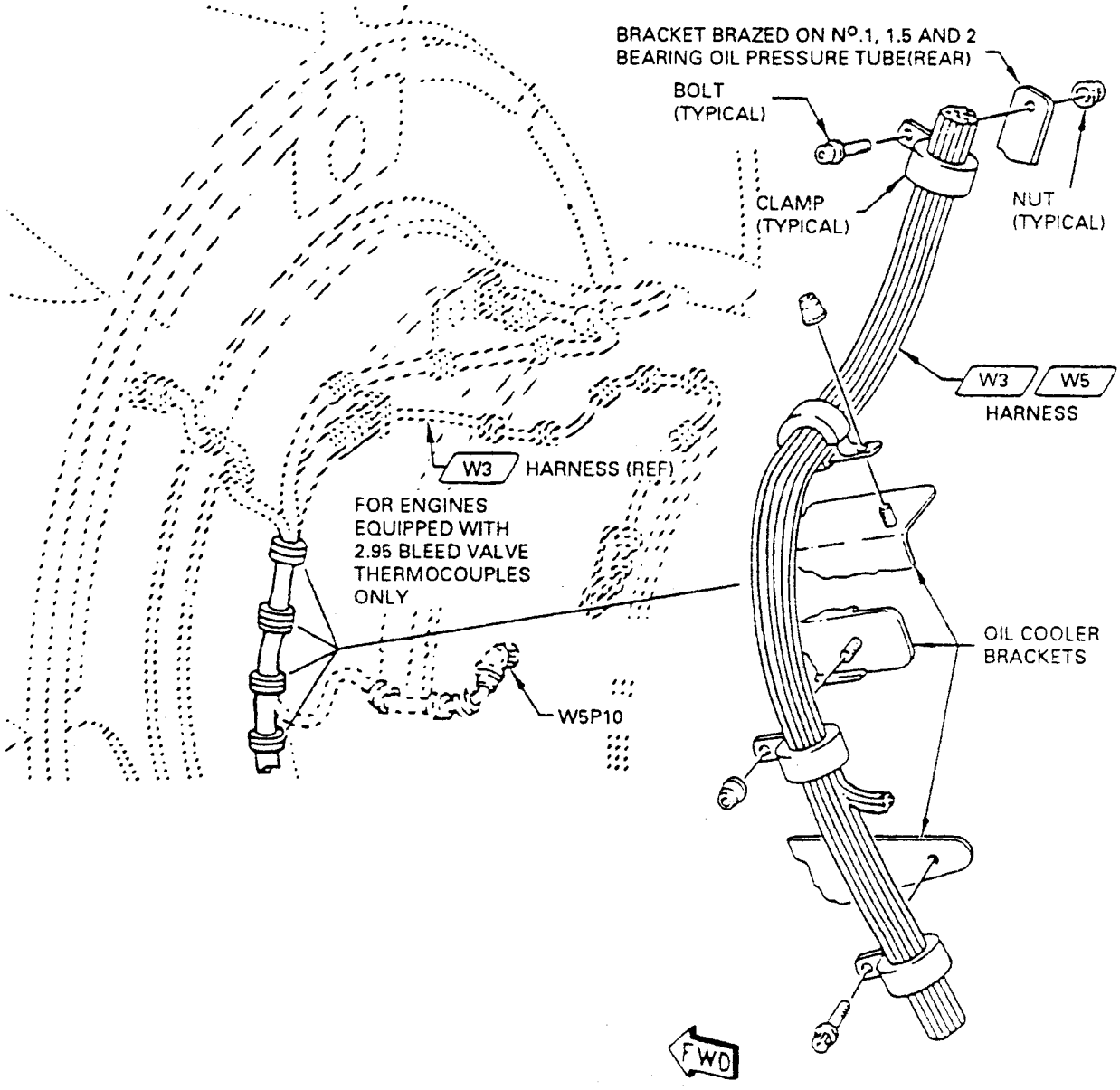
FADEC Core Engine W3 Wiring Harness - Figure B
Figure 413


TUBE (AA06)
TUBE (AA30)
BRACKET ON FLANGE J (ADJACENT TO AIR FILTER)
W3 HARNESS
BRACKET ON FLANGE J
TUBE (AA19)
TUBE (AA19)
BRACKET ON 2.95 BLEED VALVE
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
L-A8433 (000(
BM5 73 24 08 4 KFC0 00

FADEC Core Engine W3 Wiring Harness - Figure C
Figure 414


TUBE (AA06)
TUBE (AA30)
BRACKET ON FLANGE J (ADJACENT TO AIR FILTER)
W3 HARNESS
BRACKET ON FLANGE J
TUBE (AA19)
TUBE (AA19)
BRACKET ON 2.95 BLEED VALVE
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
L-B2345 (0000)
BM5 73 24 08 4 KFDO 00

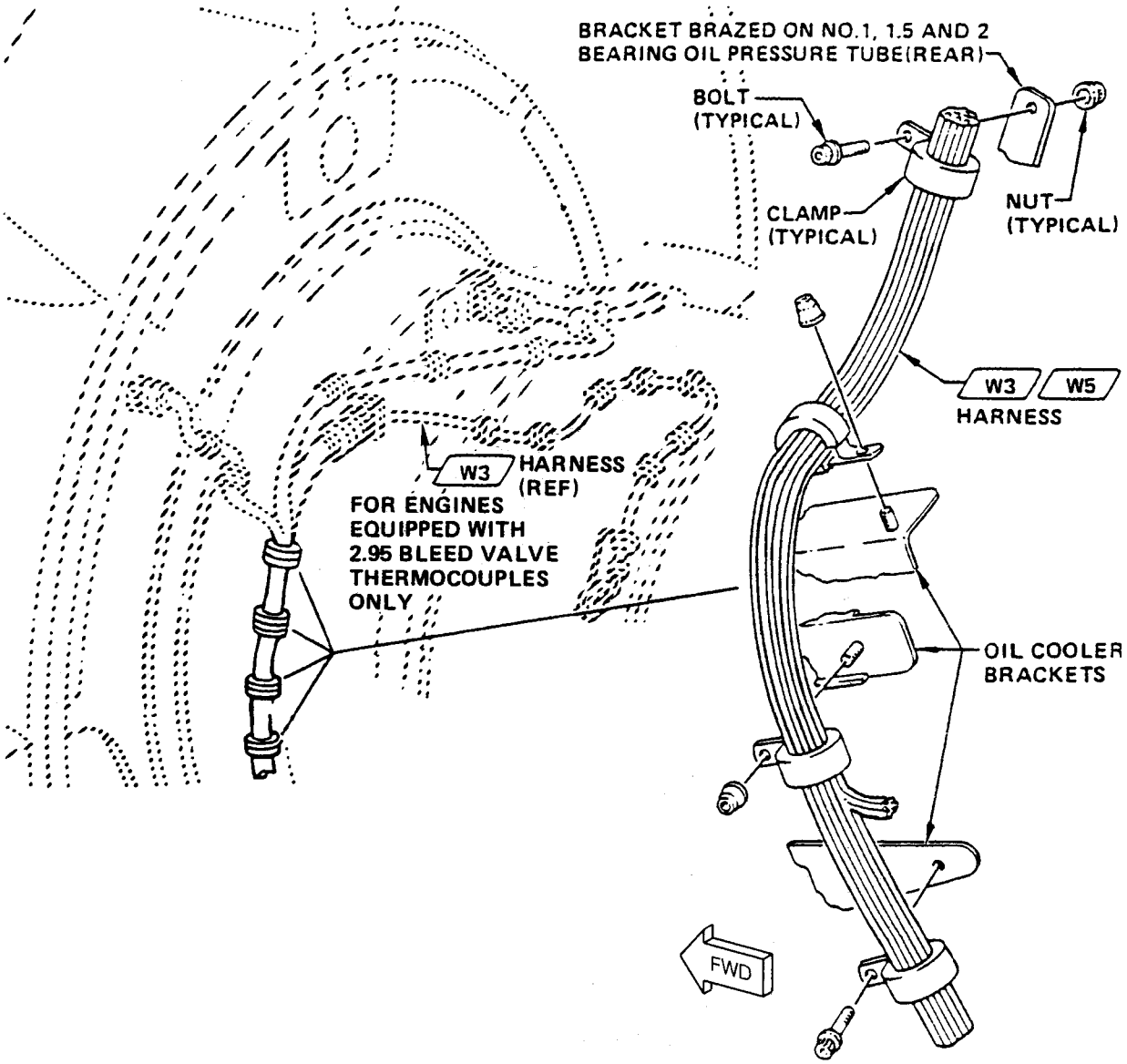
FADEC Core Engine W3 Wiring Harness - Figure C
Figure 415



BM5 73 24 08 4 KGC0 00

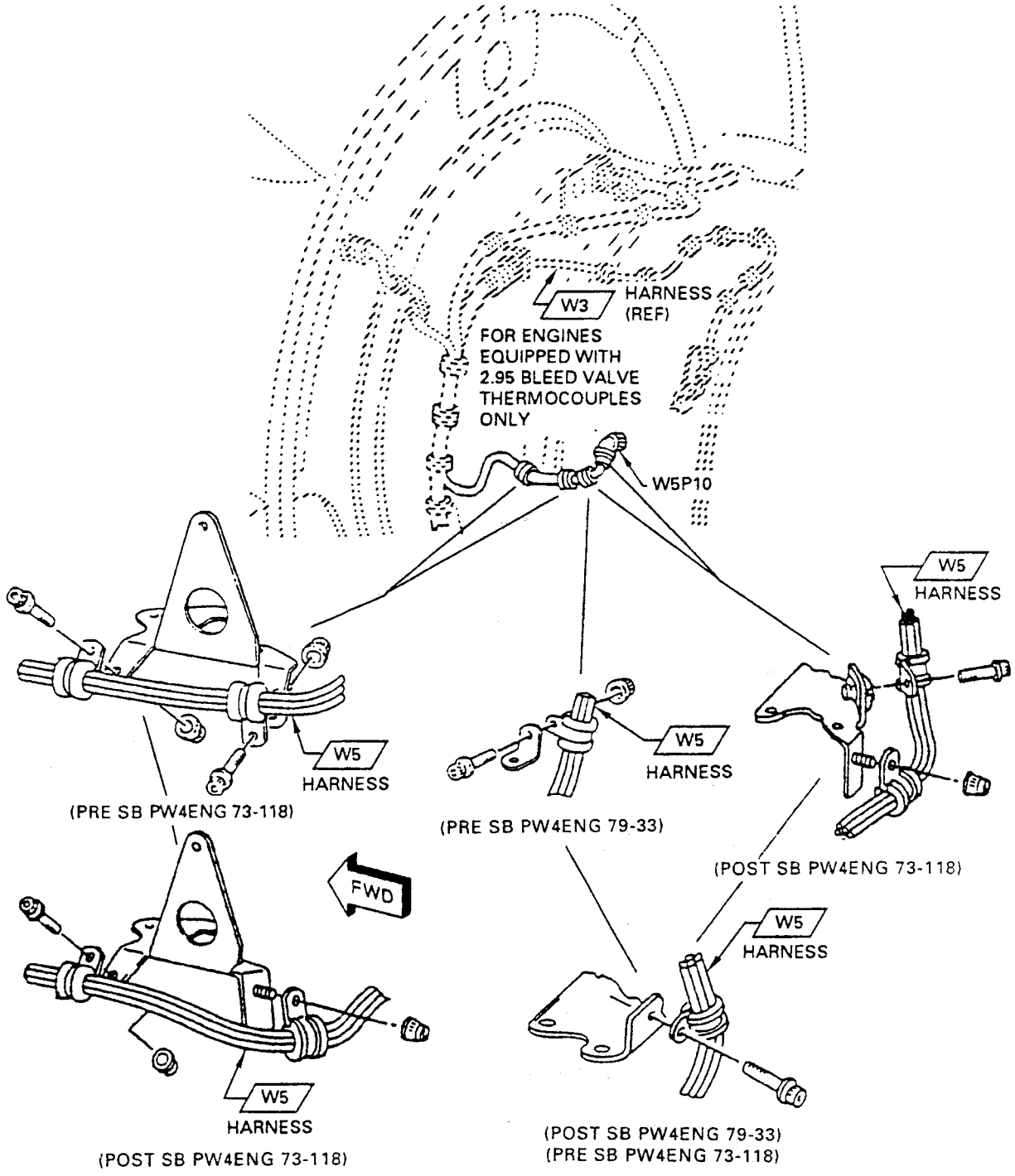
FADEC Core Engine W3 Wiring Harness - Figure D
Figure 416

R



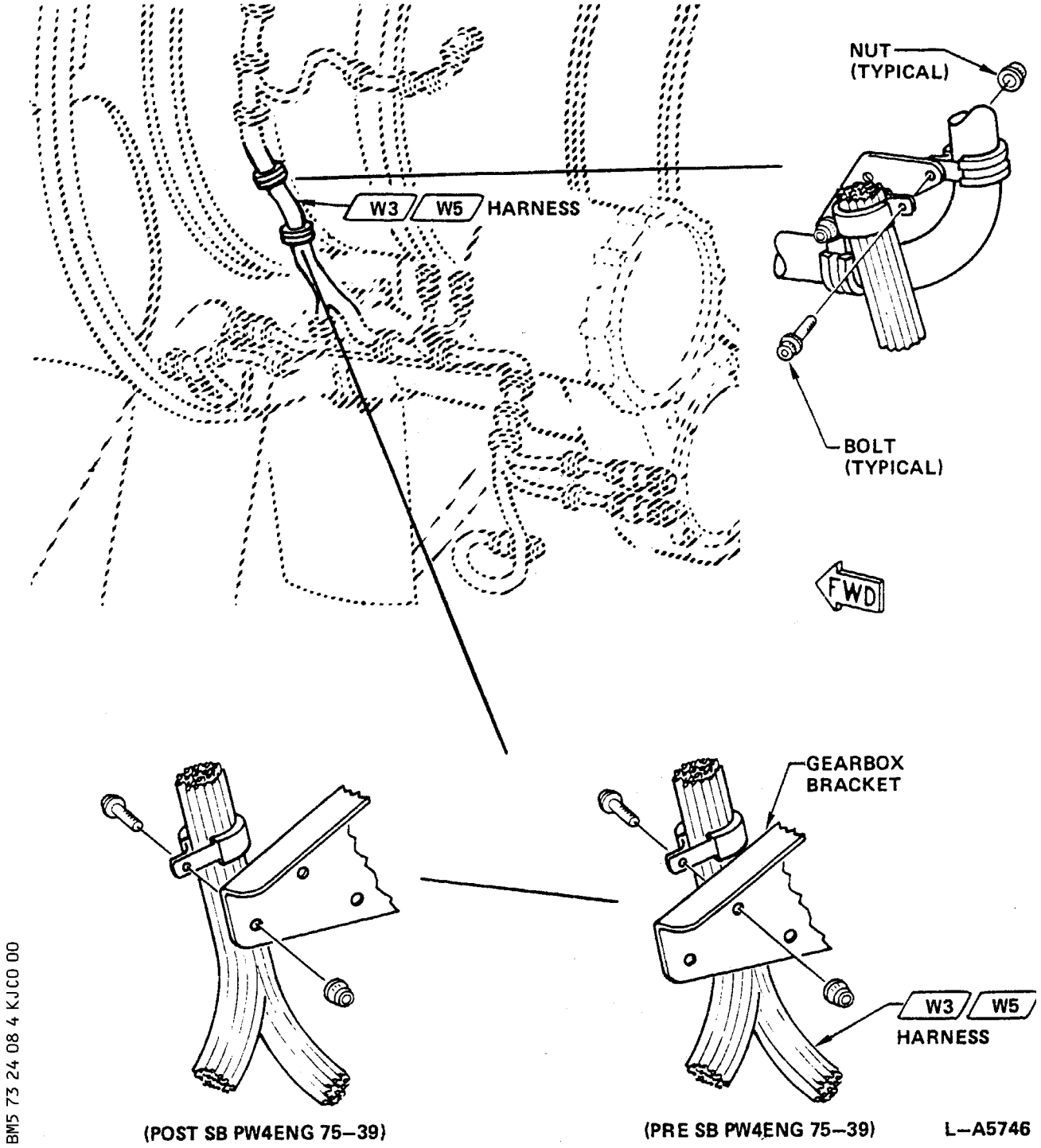
BM5 73 24 08 4 KGDO 00

FADEC Core Engine W3 Wiring Harness - Figure D
Figure 417

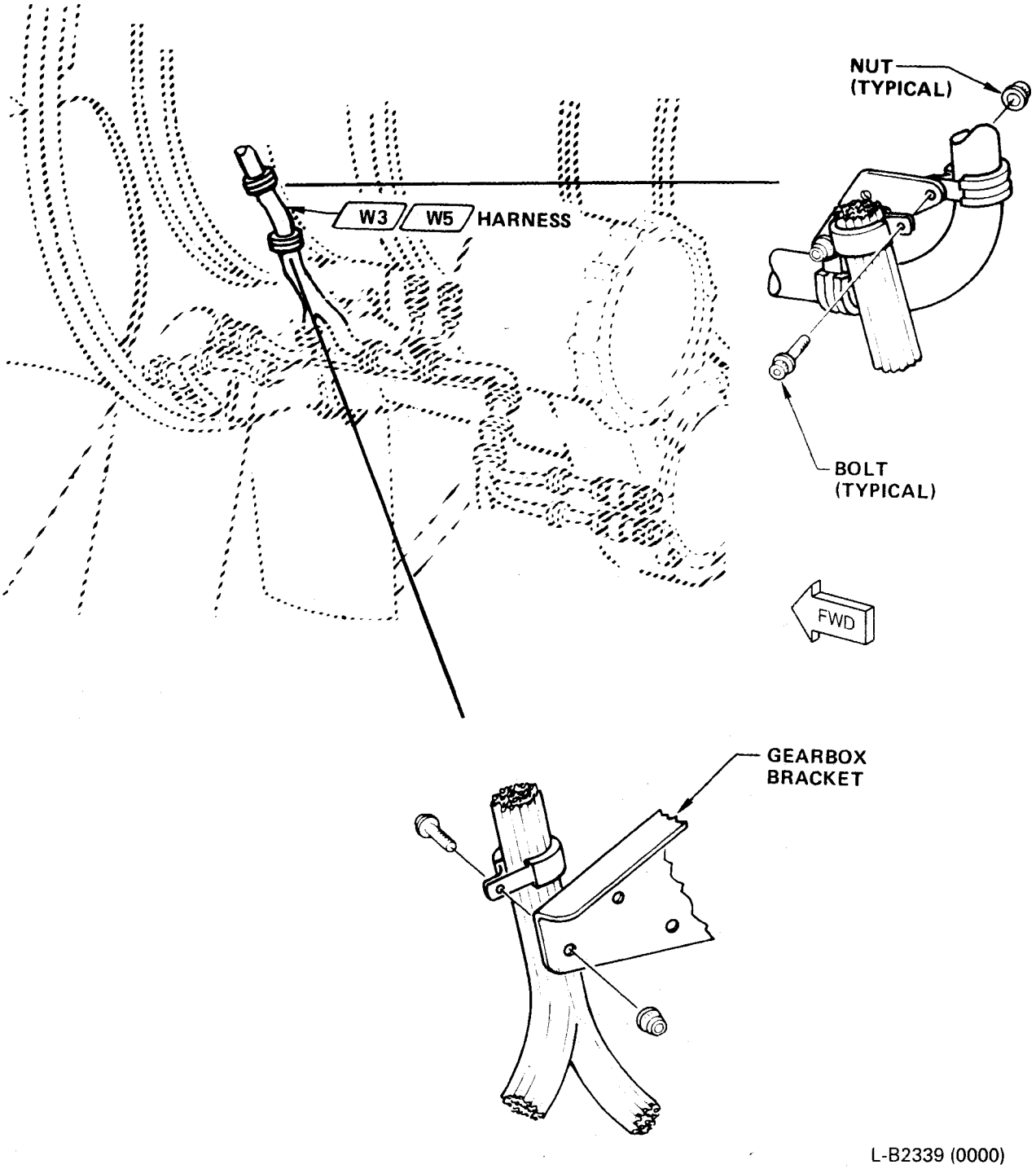


BM5 73 24 08 4 KHC0 00

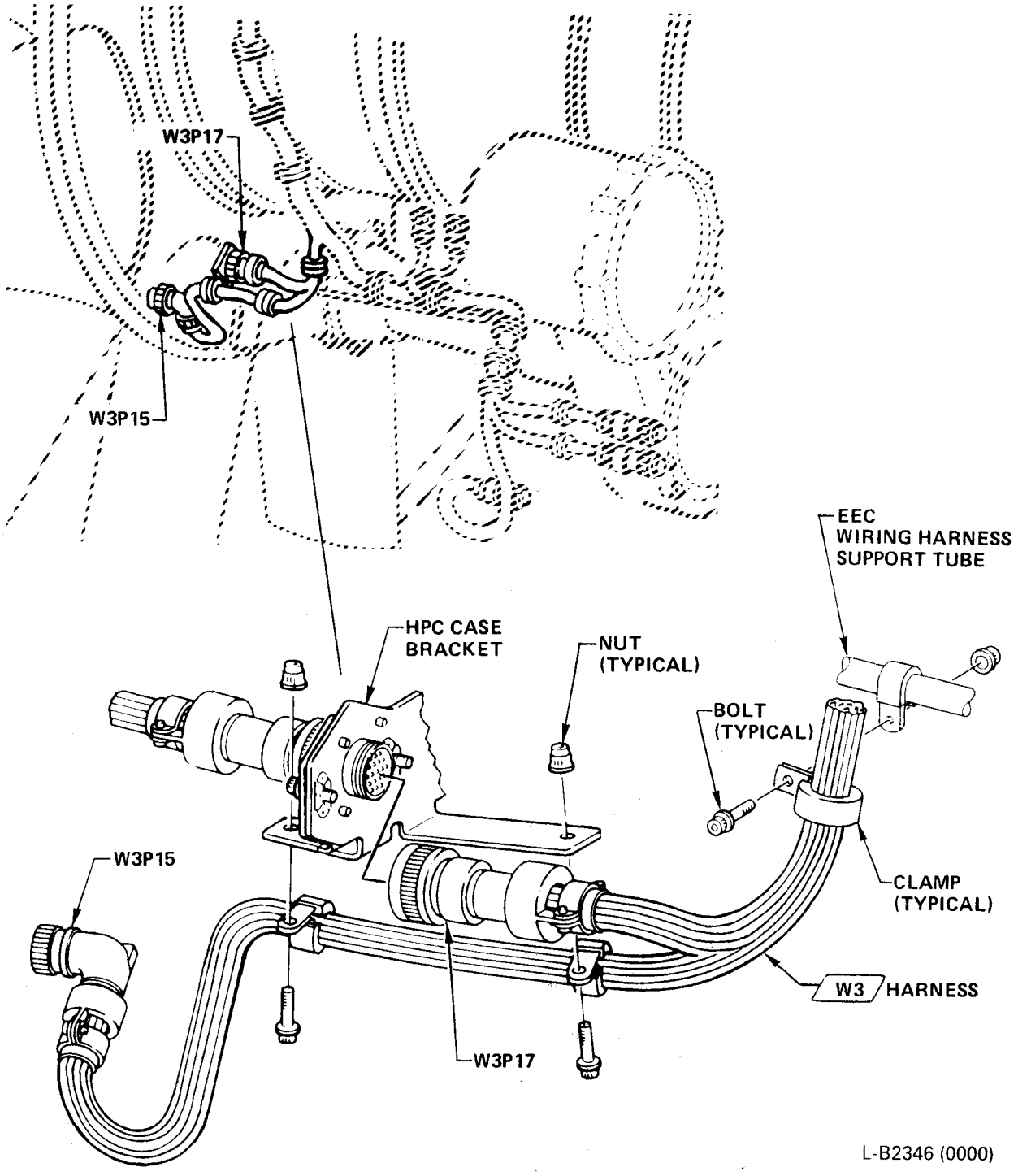
FADEC Core Engine W3 Wiring Harness - Figure E
Figure 418



FADEC Core Engine W3 Wiring Harness - Figure F
Figure 419



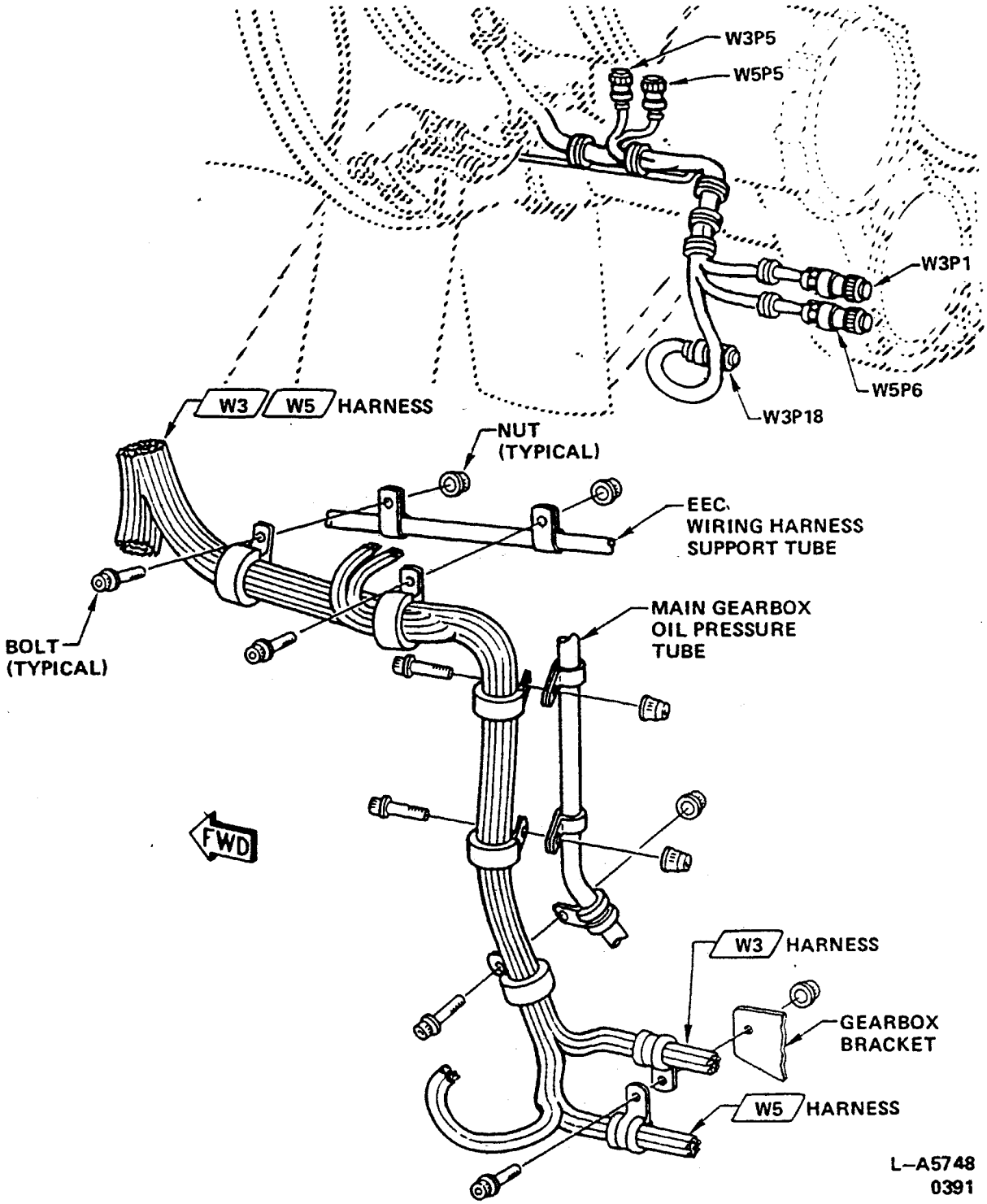
FADEC Core Engine W3 Wiring Harness - Figure F
Figure 420



BM5 73 24 08 4 KKD0 00

FADEC Core Engine W3 Wiring Harness - Figure G
Figure 421

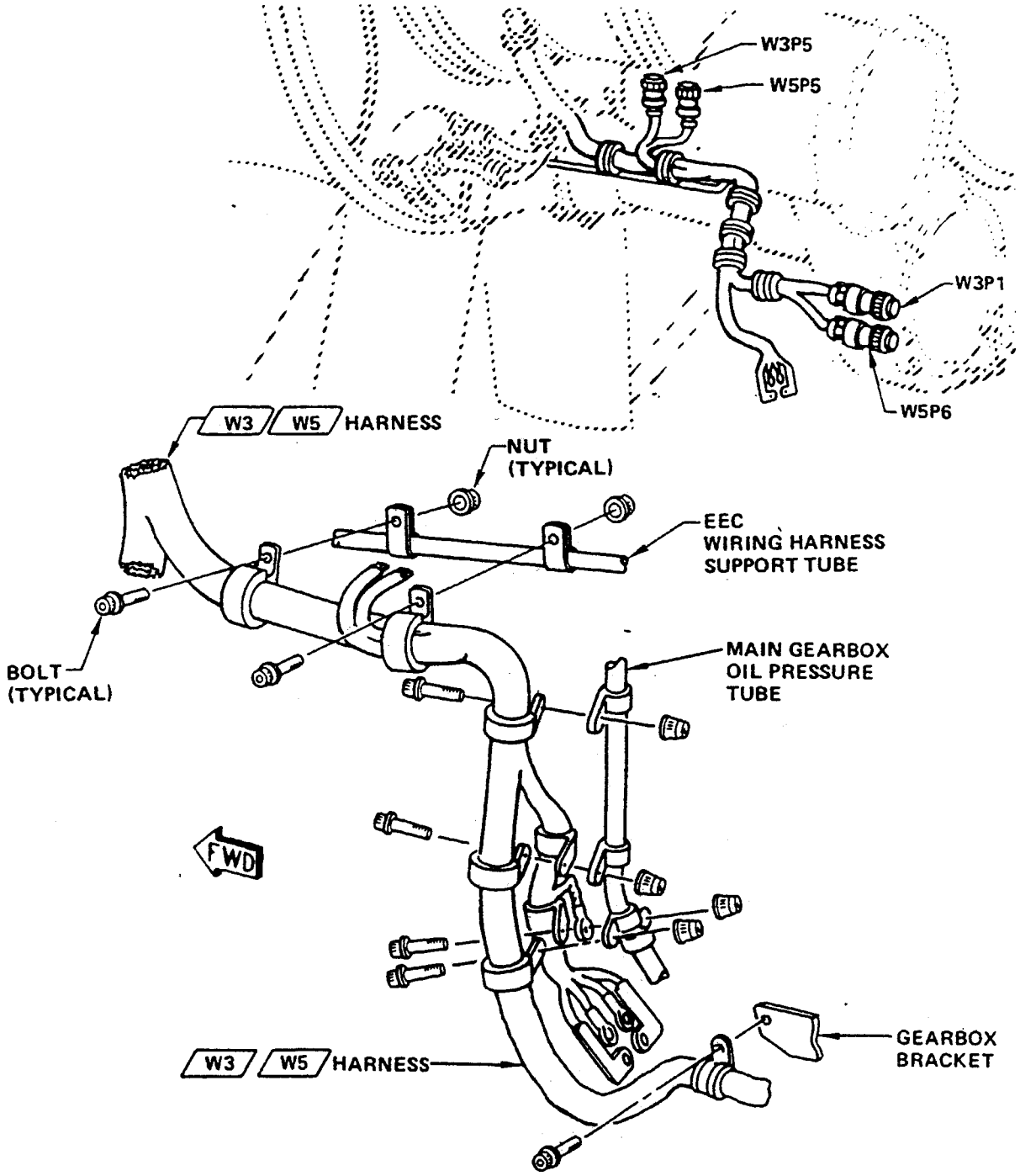
R



BM5 73 24 08 4 KLC0 00

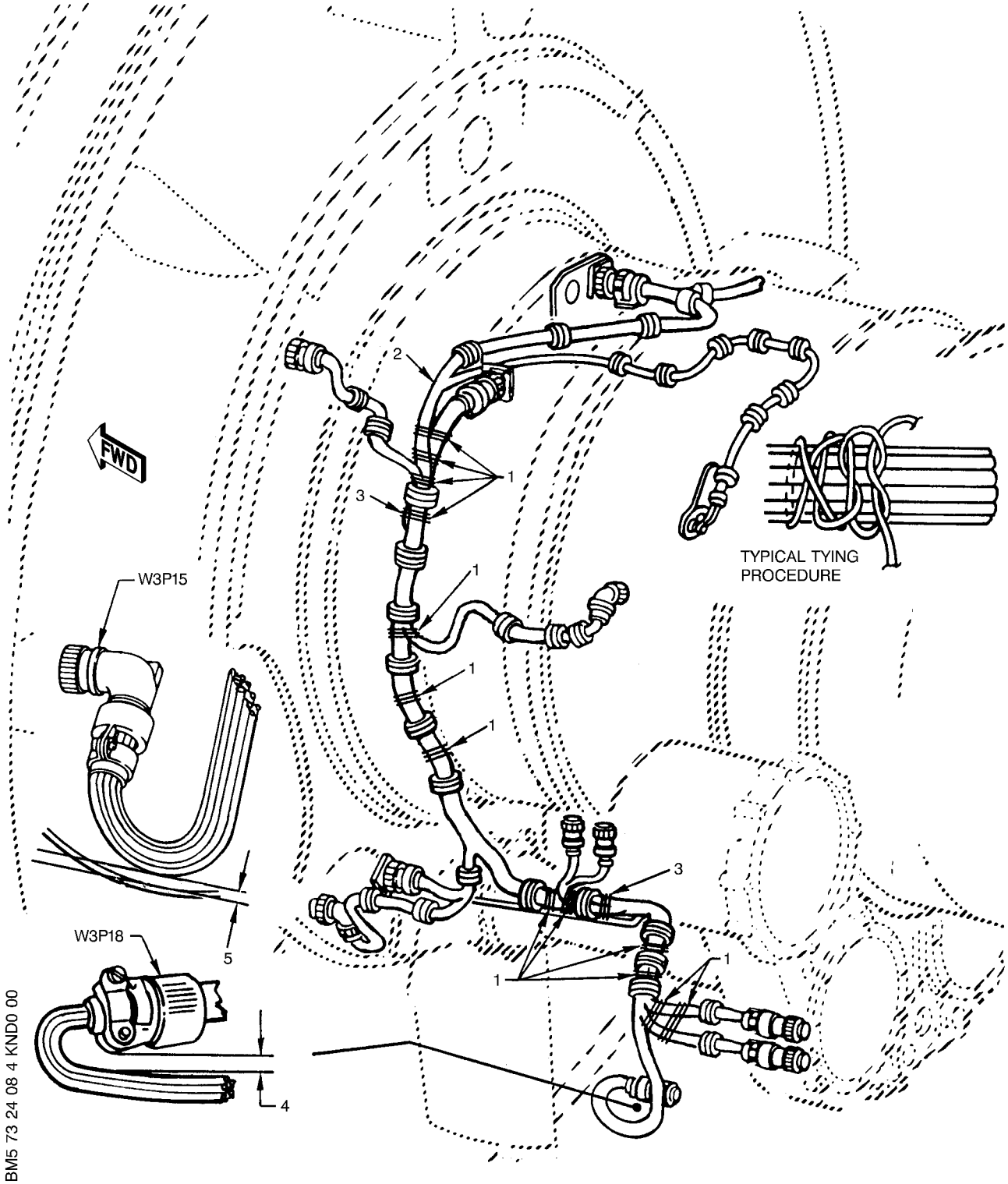
FADEC Core Engine W3 Wiring Harness - Figure H
(Pre SB PW4ENG 73-84)
Figure 422

R

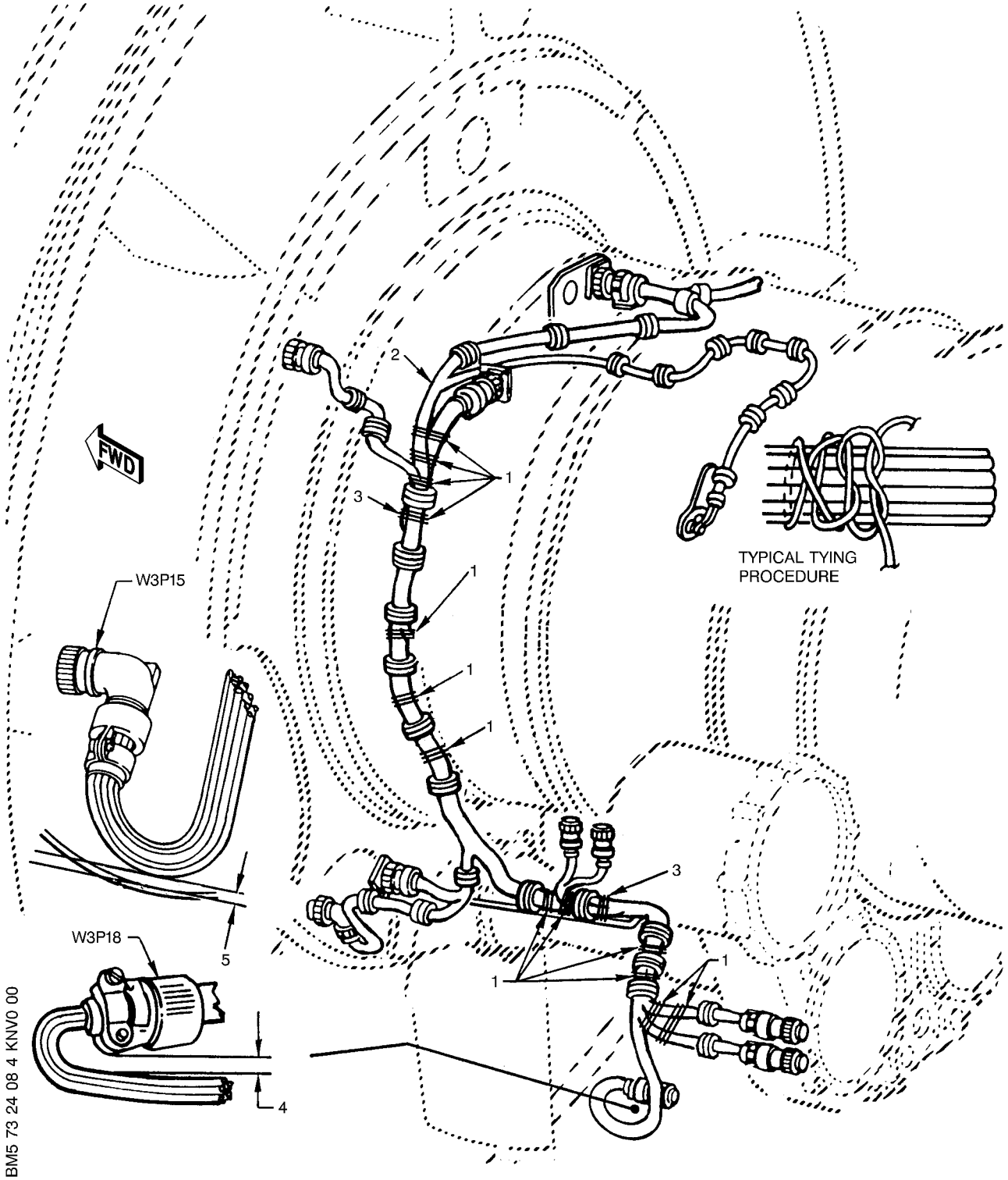


BM5 73 24 08 4 KMCO 00

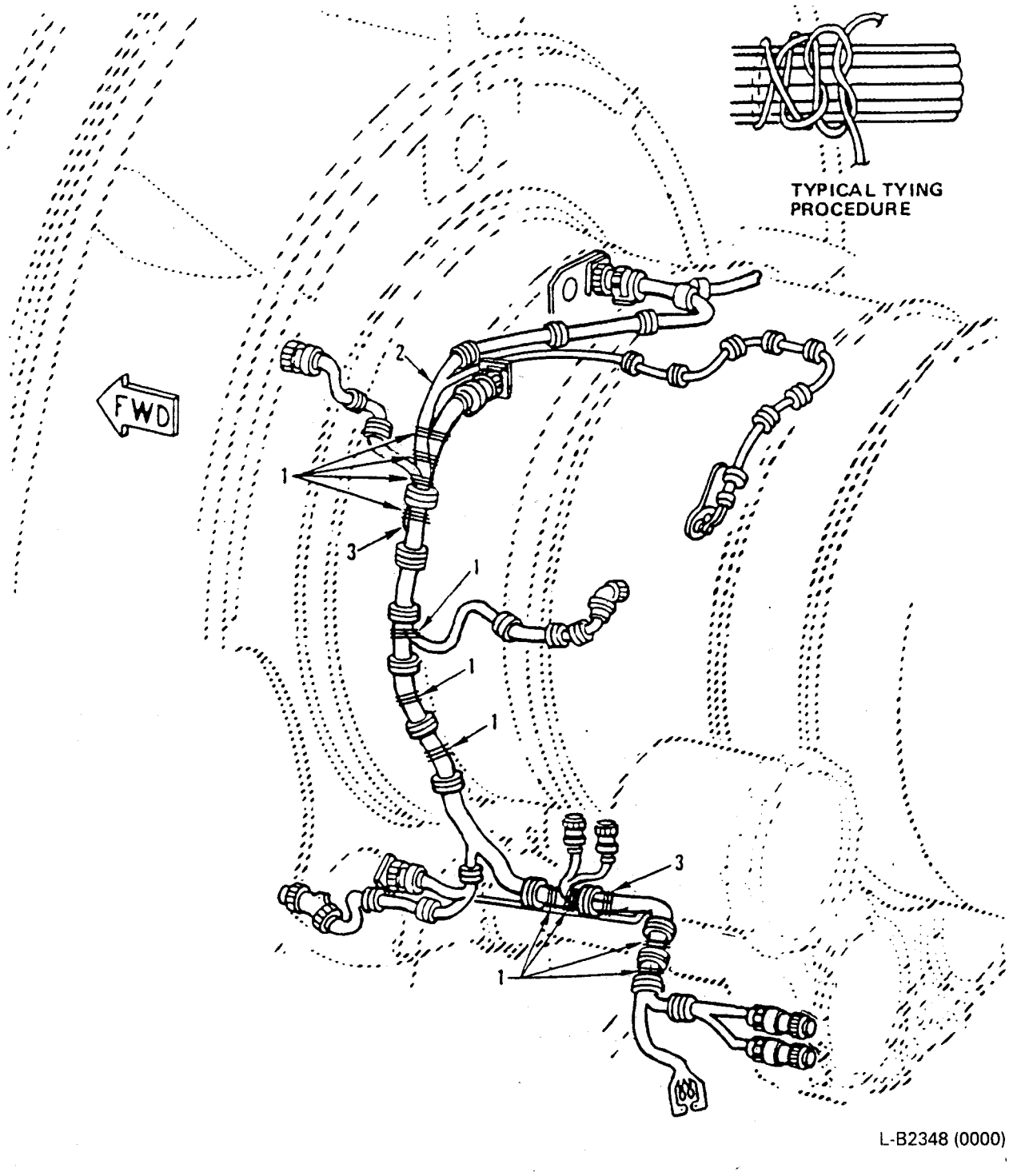
FADEC Core Engine W3 Wiring Harness - Figure J
(Post SB PW4ENG 73-84)
Figure 423



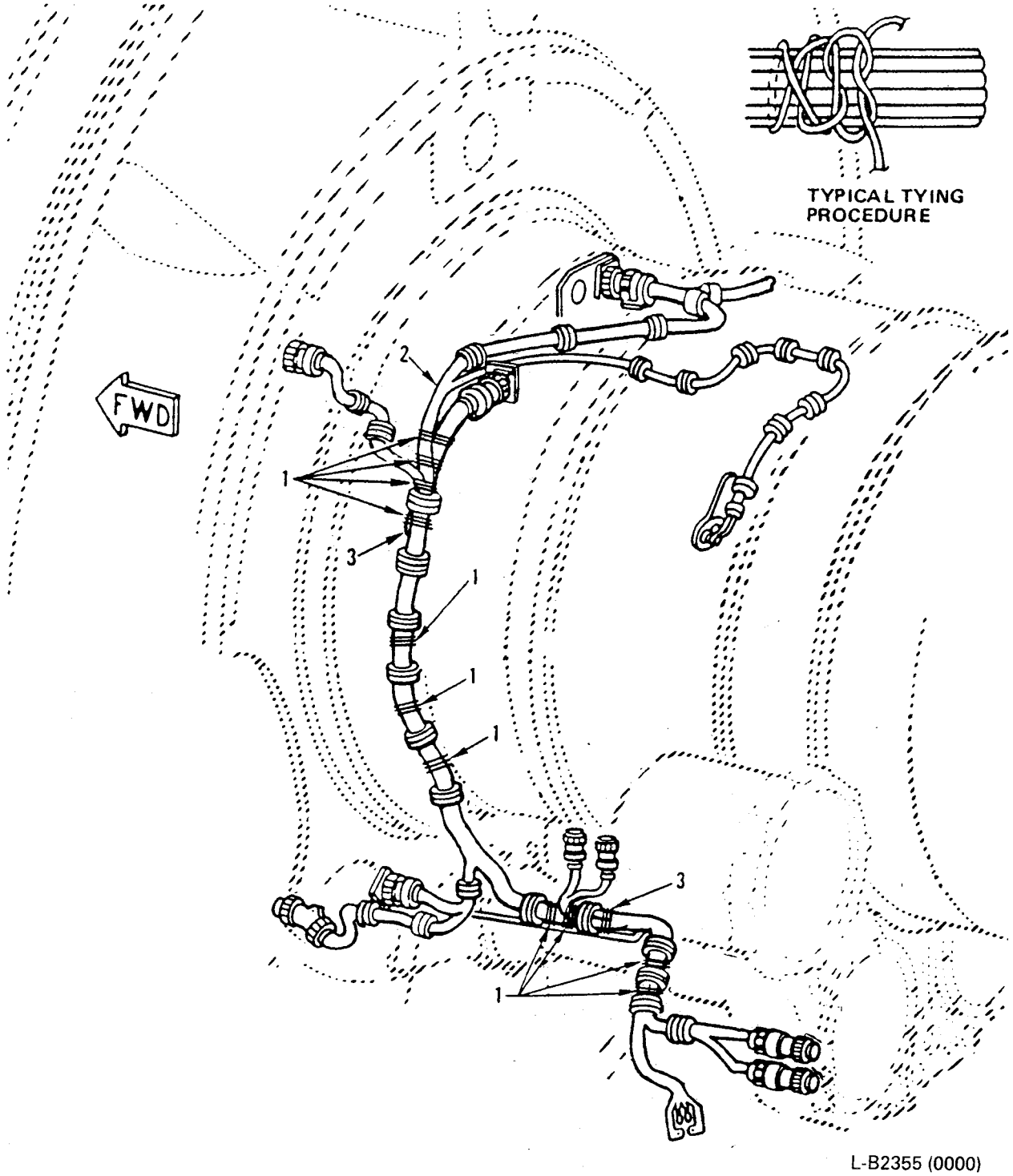
FADEC Core Engine W3 Wiring Harness (Pre SB PW4ENG 73-84)
Figure 424



FADEC Core Engine W3 Wiring Harness (Pre SB PW4ENG 73-84)
Figure 425



FADEC Core Engine W3 Wiring Harness (Post SB PW4ENG 73-84)
Figure 426



FADEC Core Engine W3 Wiring Harness (Post SB PW4ENG 73-84)
Figure 427

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

ITEM	DESIGNATION
1.	Tie
2.	The Harness Must Be Put Forward in this Location.
3.	Make a Loop in the Harness and Put the Loop Through the Clamp. Tie the Loop and the Harness Together.
4.	0.375 in. (9.525 mm) Clearance Required Between the W3P18 Connector and the Harness
5.	0.500 in. (12.700 mm) Clearance Required Between the W3P15 Connector and the Case.

Key to figure (Ref. Fig. 425)

**ON A/C 101-200,

ITEM	DESIGNATION
1.	Tie
2.	The Harness Must Be Put Forward in this Location.
3.	Make a Loop in the Harness and Put the Loop Through the Clamp. Tie the Loop and the Harness Together.

Key to figure (Ref. Fig. 426)

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

ITEM	DESIGNATION
1.	Tie
2.	The Harness Must Be Put Forward in this Location.
3.	Make a Loop in the Harness and Put the Loop Through the Clamp. Tie the Loop and the Harness Together.

Key to figure (Ref. Fig. 427)

**ON A/C 101-200,

5. FADEC Core Engine W4 Wiring Harness

NOTE : This procedure provides the removal/installation of the FADEC core engine W4 wiring harness.

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.A.	19KS	332/U70
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.B.	21KS	331/V70
133VU	ENG1 - SCU SUPPLY - GND	35KS	333/T76
133VU	ENG1 - SCU SUPPLY - FLT	37KS	333/T75
Engine 2			
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.A.	18KS	332/U71
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.B.	20KS	331/V69
133VU	ENG2 - SCU SUPPLY GND	34KS	333/T85
133VU	ENG2 - SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 428, 429, 431)
(Ref. Fig. 433, 434, 436)
(Ref. Fig. 437, 438, 439)
(Ref. Fig. 441, 442, 444)
(Ref. Fig. 445, 446)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE REMOVAL, OR

DAMAGE TO THE HARNESS CAN OCCUR.

NOTE : (Ref. Fig. 429) identifies the reference figure for each connector.
(Ref. Fig. 431) identifies the connector to component locations.

(1)Disconnect the W1P25 harness connector from the W4J25 harness connector located at the 1 o'clock position on the HPC case.

(a)Remove the two bolts and harness bracket attaching the W4J25 harness connector flange to the HPC case bracket. Remove the connector from the bracket.
Install a protective closure on each harness connector.
(Ref. Fig. 436).

(2)Disconnect the following harness connectors from the components given below. Install a protective closure on each harness connector and mating receptacle.

R

Connector	Component	Location
W4P16	Turbine Case Cooling (TCC) Air Valve Actuator	2 o'clock
W4P21	Turbine Vane and Blade Cooling Air Valve	3 o'clock
W4P10	HPC Secondary Flow Control Valve	3:30 o'clock
W4P3	Variable Stator Vane Actuator (Lower Connector)	4 o'clock
W4P19	EEC Speed Transducer (N1)	Intermediate Case 4:30 o'clock
W4P23	EEC Speed Transducer (N1) (Engine Incorporating PMUX or SCU)	Intermediate Case 4:30 o'clock
W4P2	Fuel Metering Unit (Forward Connector)	Front of Fuel Pump 5 o'clock
W4P4	Ninth Stage Start Stability (2.9) Bleed Valve Solenoid (Outboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W4P4 Harness Connector.		

(3)Remove the bolts, nuts, and clamps that attach the W4 harness to the brackets and tubes on the HPC case.
(4)Remove the applicable harness ties and carefully remove the W4 harness.
(5)Install protective closures.
(6)Remove the harness support brackets, if necessary, from the right side of the HPC case.

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

B. Removal (Ref. Fig. 428, 430, 432)
(Ref. Fig. 433, 435, 436)
(Ref. Fig. 437, 438, 440)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 447)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE REMOVAL, OR DAMAGE TO THE HARNESS CAN OCCUR.

NOTE : (Ref. Fig. 430) identifies the reference figure for each connector.
(Ref. Fig. 432) identifies the connector to component locations.

(1)Disconnect the W1P25 harness connector from the W4J25 harness connector located at the 1 o'clock position on the HPC case.

(a)Remove the two bolts and harness bracket attaching the W4J25 harness connector flange to the HPC case bracket. Remove the connector from the bracket.
Install a protective closure on each harness connector.
(Ref. Fig. 436).

(2)Disconnect the following harness connectors from the components given below. Install a protective closure on each harness connector and mating receptacle.

Connector	Component	Location
W4P16	Turbine Case Cooling (TCC) Air Valve Actuator	2 o'clock
W4P3	Variable Stator Vane Actuator (Lower Connector)	4 o'clock
W4P19	EEC Speed Transducer (N1)	Intermediate Case 4:30 o'clock
W4P23	EEC Speed Transducer (N1) (Engine Incorporating PMUX or SCU)	Intermediate Case 4:30 o'clock
W4P2	Fuel Metering Unit (Forward Connector)	Front of Fuel Pump 5 o'clock
W4P4	Ninth Stage Start Stability (2.9) Bleed Valve Solenoid (Outboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector disconnect the W4P4 Harness Connector.		Torque Adapter to

(3)Remove the bolts, nuts, and clamps that attach the W4 harness to the brackets and tubes on the HPC case.
(4)Remove the applicable harness ties and carefully remove the W4 harness.
(5)Install protective closures.
(6)Remove the harness support brackets, if necessary, from the right side of the HPC case.

**ON A/C 101-200,

C. Installation (Ref. Fig. 428, 429, 431)
(Ref. Fig. 433, 434, 436)
(Ref. Fig. 437, 438, 439)
(Ref. Fig. 441, 442, 444)
(Ref. Fig. 445, 446)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

NOTE : Be sure and use the correct part number W4 wiring harness for replacement. Interchangeability with the start/stability bleed valve solenoid (5 o'clock position) is affected (See SB PW4 ENG. 73-70 for selection).

(1)If the top and lower harness support brackets (1), (5) have been previously removed from the right side of the HPC case, install the brackets as follows (Ref. Fig. 428) :
(a)Install the top harness support bracket (1) to the turbine cooling valve actuator bracket (2) and to the bracket (3) on the compressor stator cylinder support. Attach the support bracket (1) with bolts, threads lubricated with Material No.P03-001, washers (next to the bolt heads) and nuts. TORQUE the bolts and nut to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(b)Install the lower harness support bracket (5) to the outer face of the cross brace on the compressor stator cylinder support (4). Attach the support bracket (5) with bolts, threads lubricated with Material No.P03-001, (bolt heads inboard), washers (next to nuts) and nuts. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(c)Attach brackets (6) to the inner face of the lower harness support bracket (5) with bolts, threads lubricated with Material No.P03-001, (bolt heads outboard), washer (next to bolt heads) and nuts handtight.
(d)Put a feeler gage between the end of the bracket (6) and the compressor stator cylinder support (7) so that the brackets are parallel with each other and the bolts installed in step (c), are aligned in the bolt holes. Have a second person TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) while holding the brackets in position along with the feeler gage.
(e)Remove the feeler gage and find the thickness used. Record the thickness. Use a minimum amount of shims. Use shims 0 - 4 (0.038 - 0.048 inch) (0.965 - 1.219 mm) and/or shims 0 - 3 (0.022 - 0.028 inch) (0.559 - 0.711 mm), as required, that will be equal to, or up to 0.010 inch (0.254 mm) less than the thickness recorded.
(f)Install the shims between the brackets. Align the bolt holes and attach the brackets together with bolts, threads lubricated with Material

No.P03-001, (bolt heads up) and nuts. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN). Make sure a maximum gap of 0.010 inch (0.254 mm) is between the shims and the brackets after the bolts are torqued.

(2)Install the W4 harness on the right side of the engine.

(a)Remove the protective closure. Install the W4J25 connector flange to the HPC case bracket located at the 1 o'clock position. Install the harness bracket (cut-out rearward) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 436).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.
MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(3)Remove the protective closures. Connect the W4P10 harness connector to the HPC secondary flow control valve located at the 3:30 o'clock position.

(a)(Reference 2154) Tighten and TORQUE the connector to between 21 and 26 lbf.in. (0.24 and 0.29 m.daN). Wirelock the connector nut with AS3214-01.

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.
MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(4)Remove the protective closures. Connect the W4P21 harness connector to the turbine vane and blade cooling air valve located at the 3 o'clock position.

(a)(Reference 2156) Tighten and TORQUE the connector to between 30 and 35 lbf.in. (0.34 and 0.39 m.daN). Wirelock the connector nut with AS3214-01.

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

(5)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

For the connector to component locations (Ref. Fig. 431, 433, 434)

	Connector	Component	Location
	W4P16	Turbine Case Cooling (TCC) Air Valve Actuator	2 o'clock
	W4P2	Fuel Metering Unit (Forward Connector)	Front of Fuel Pump 5 o'clock
	W4P3	Variable Stator Vane Actuator (Lower Connector)	4 o'clock
	W4P4	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Outboard Connector)	Intermediate Case 5 o'clock
	NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W4P4 harness connector.		
	W4P19	FADEC Speed Transducer (N1)	Intermediate Case 4:30 o'clock
	W4P23	FADEC Speed Transducer (N1) (Engines Incorporating PMUX or SCU)	Intermediate Case 4:30 o'clock
	W1P25	Harness Connector to W4J25 Harness Connector	1 o'clock

(6)Adjust the W4 harness for any necessary clearances as required.
Install the clamps at all clamp points.
Refer to the figures. Attach the clamps loosely to the engine with bolts, spacers and/or nuts, threads lubricated with Material No.P03-001.
NOTE : Use different clamp sizes on the harnesses to prevent harness movement when tightened.

(7)Make sure that the harnesses are not tight to the point where sharp bends are caused, and that the harnesses do not touch any engine parts or plumbing. Provide a drip loop on the leads where the wires run downward into the connector.

(8)TORQUE all the previously installed clamp nuts and/or bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(9)Tie the harnesses as shown.
NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown (Ref. Fig. 446). The clove hitch and square knot must be tightened satisfactorily in place. The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled.
Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

C. Installation (Ref. Fig. 428, 430, 432)
(Ref. Fig. 433, 435, 436)
(Ref. Fig. 437, 438, 440)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 447)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

NOTE : Be sure and use the correct part number W4 wiring harness for replacement. Interchangeability with the start/stability bleed valve solenoid (5 o'clock position) is affected (See SB PW4 ENG. 73-70 for selection).

(1)If the top and lower harness support brackets (1), (5) have been previously removed from the right side of the HPC case, install the brackets as follows (Ref. Fig. 428) :

(a)Install the top harness support bracket (1) to the turbine cooling valve actuator bracket (2) and to the bracket (3) on the compressor stator cylinder support. Attach the support bracket (1) with bolts, threads lubricated with Material No.P03-001, washers (next to the bolt heads) and nuts. TORQUE the bolts and nut to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(b)Install the lower harness support bracket (5) to the outer face of the cross brace on the compressor stator cylinder support (4). Attach the support bracket (5) with bolts, threads lubricated with Material No.P03-001, (bolt heads inboard), washers (next to nuts) and nuts. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(c)Attach brackets (6) to the inner face of the lower harness support bracket (5) with bolts, threads lubricated with Material No.P03-001, (bolt heads outboard), washer (next to bolt heads) and nuts handtight.

(d)Put a feeler gage between the end of the bracket (6) and the compressor stator cylinder support (7) so that the brackets are parallel with each other and the bolts installed in step (c), are aligned in the bolt holes. Have a second person TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) while holding the brackets in position along with the feeler gage.

(e)Remove the feeler gage and find the thickness used. Record the thickness. Use a minimum amount of shims. Use shims 0 - 4 (0.038 - 0.048 inch) (0.965 - 1.219 mm) and/or shims 0 - 3 (0.022 - 0.028 inch) (0.559 - 0.711 mm), as required, that will be equal to, or up to 0.010 inch (0.254 mm) less than the thickness recorded.

(f)Install the shims between the brackets. Align the bolt holes and attach the brackets together with bolts, threads lubricated with Material No.P03-001, (bolt heads up) and nuts. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN). Make sure a maximum gap of 0.010 inch (0.254 mm) is between the shims and the brackets after the

bolts are torqued.

(2)Install the W4 harness on the right side of the engine.

(a)Remove the protective closure. Install the W4J25 connector flange to the HPC case bracket located at the 1 o'clock position. Install the harness bracket (cut-out rearward) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 436).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

(3)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

For the connector to component locations (Ref. Fig. 432, 435)

Connector	Component	Location
W4P16	Turbine Case Cooling (TCC) Air Valve Actuator	2 o'clock
W4P2	Fuel Metering Unit (Forward Connector)	Front of Fuel Pump 5 o'clock
W4P3	Variable Stator Vane Actuator (Lower Connector)	4 o'clock
W4P4	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Outboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W4P4 harness connector.		
W4P19	FADEC Speed Transducer (N1)	Intermediate Case 4:30 o'clock
W4P23	FADEC Speed Transducer (N1) (Engines Incorporating PMUX or SCU)	Intermediate Case 4:30 o'clock
W1P25	Harness Connector to W4J25 Harness Connector	1 o'clock

(4)Adjust the W4 harness for any necessary clearances as required.

Install the clamps at all clamp points.
Refer to the figures. Attach the clamps loosely to the engine with bolts, spacers and/or nuts, threads lubricated with Material No.P03-001.
NOTE : Use different clamp sizes on the harnesses to prevent harness movement when tightened.

(5)Make sure that the harnesses are not tight to the point where sharp bends are caused, and that the harnesses do not touch any engine parts or plumbing. Provide a drip loop on the leads where the wires run downward into the connector.

(6)TORQUE all the previously installed clamp nuts and/or bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(7)Tie the harnesses as shown.
NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown (Ref. Fig. 447). The clove hitch and square knot must be tightened satisfactorily in place. The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled.
Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

**ON A/C 101-200,

D. CLose-Up
(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(2)Remove safety clips and tags and close circuit breakers : 18KS, 19KS, 20KS, 21KS, 34KS, 35KS, 36KS, 37KS.

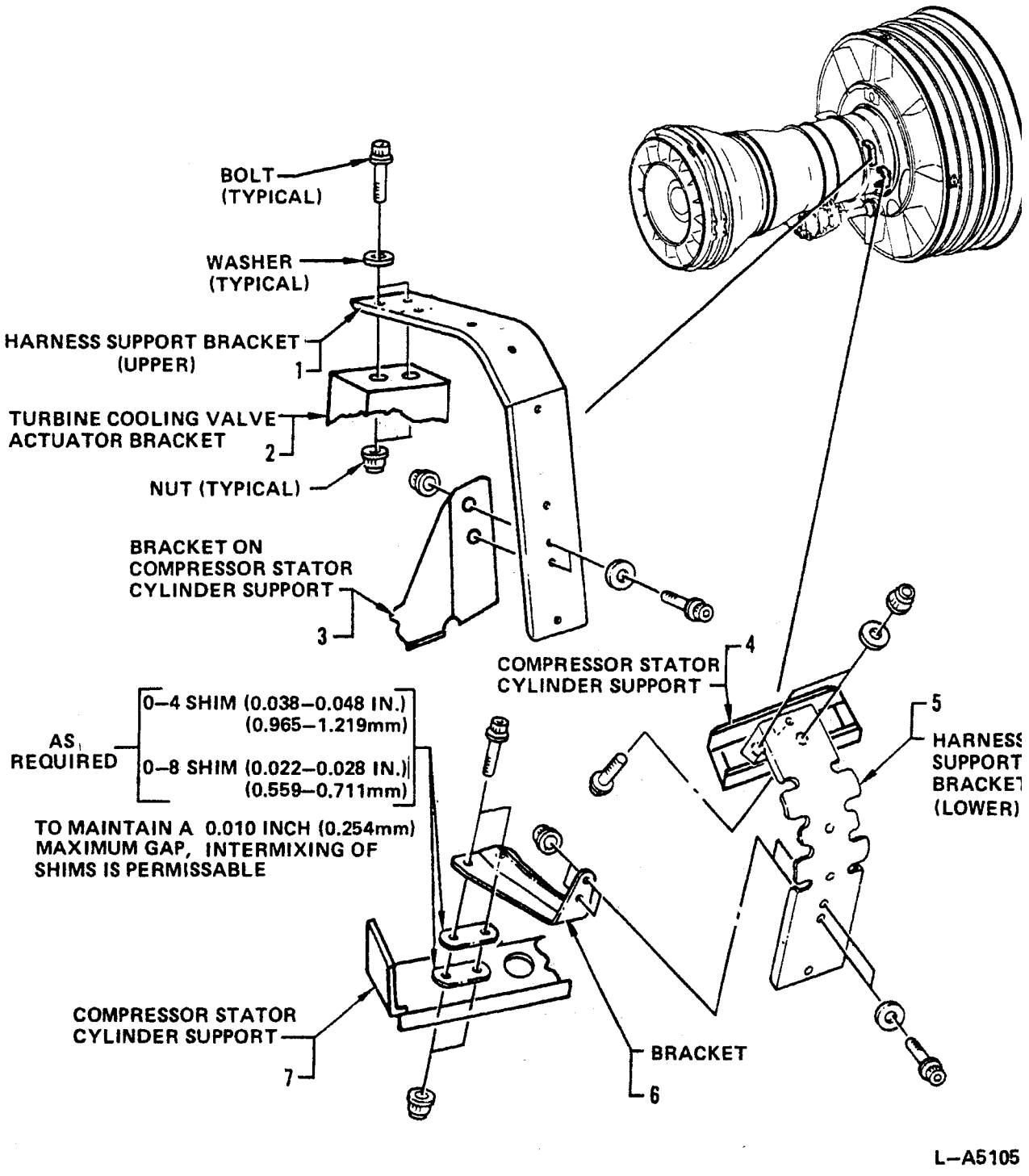
**ON A/C 101-200,

ITEM	DESIGNATION
1.	Tie
2.	Cross Tie
3.	3.000 in. (76.200 mm) Maximum Clearance Between the W5P1 and W4P2 Harness Connector Clamps and the Bottom of the Harnesses.
4.	0.375 in. (9.525 mm) Minimum Clearance Between the W4P3 Harness Connector and the W4/W5 Harnesses.

Key to Figure

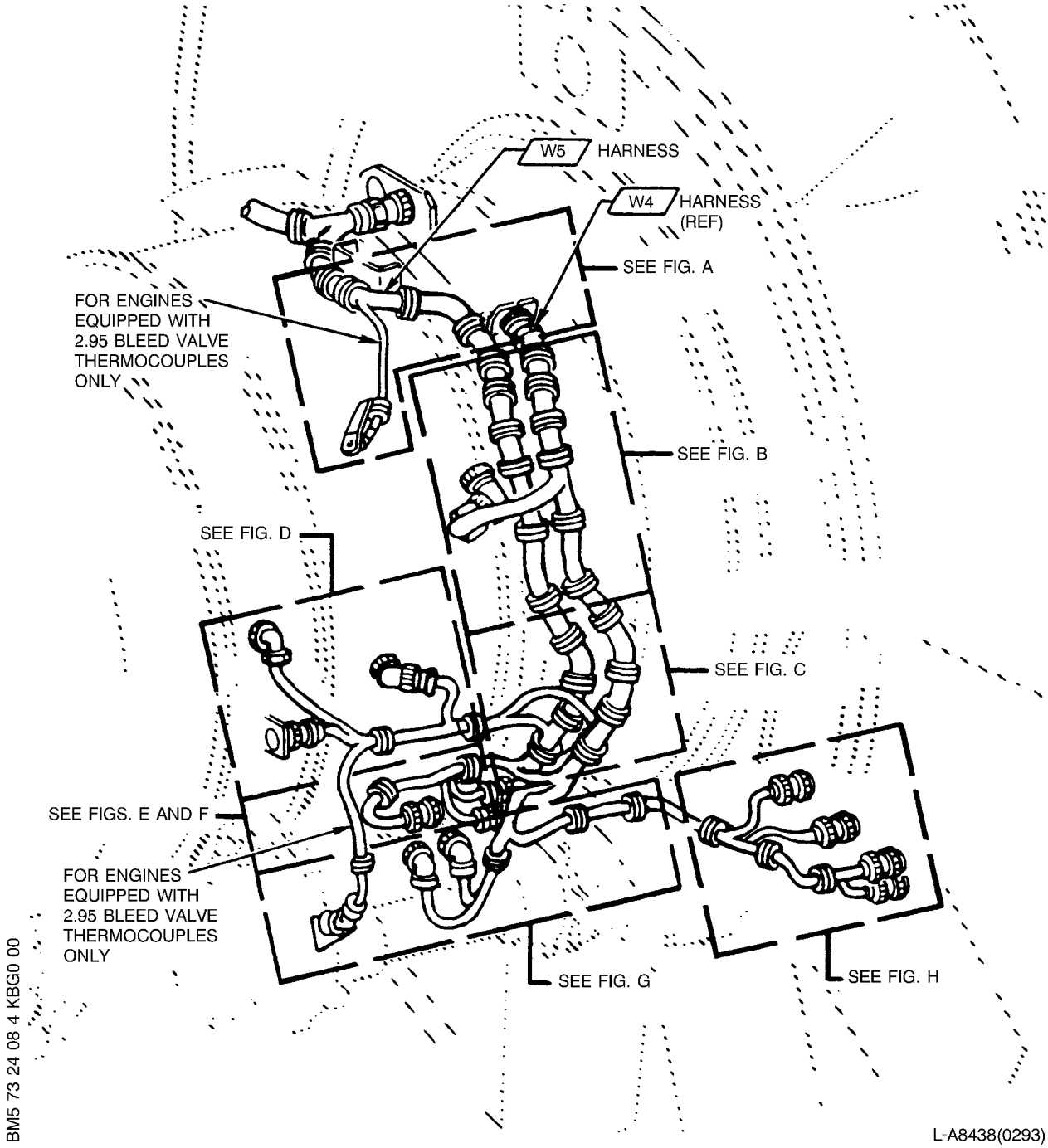
6. FADEC Core Engine W5 Wiring Harness
NOTE : This procedure provides the removal/installation of the FADEC core engine W5 wiring harness.

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

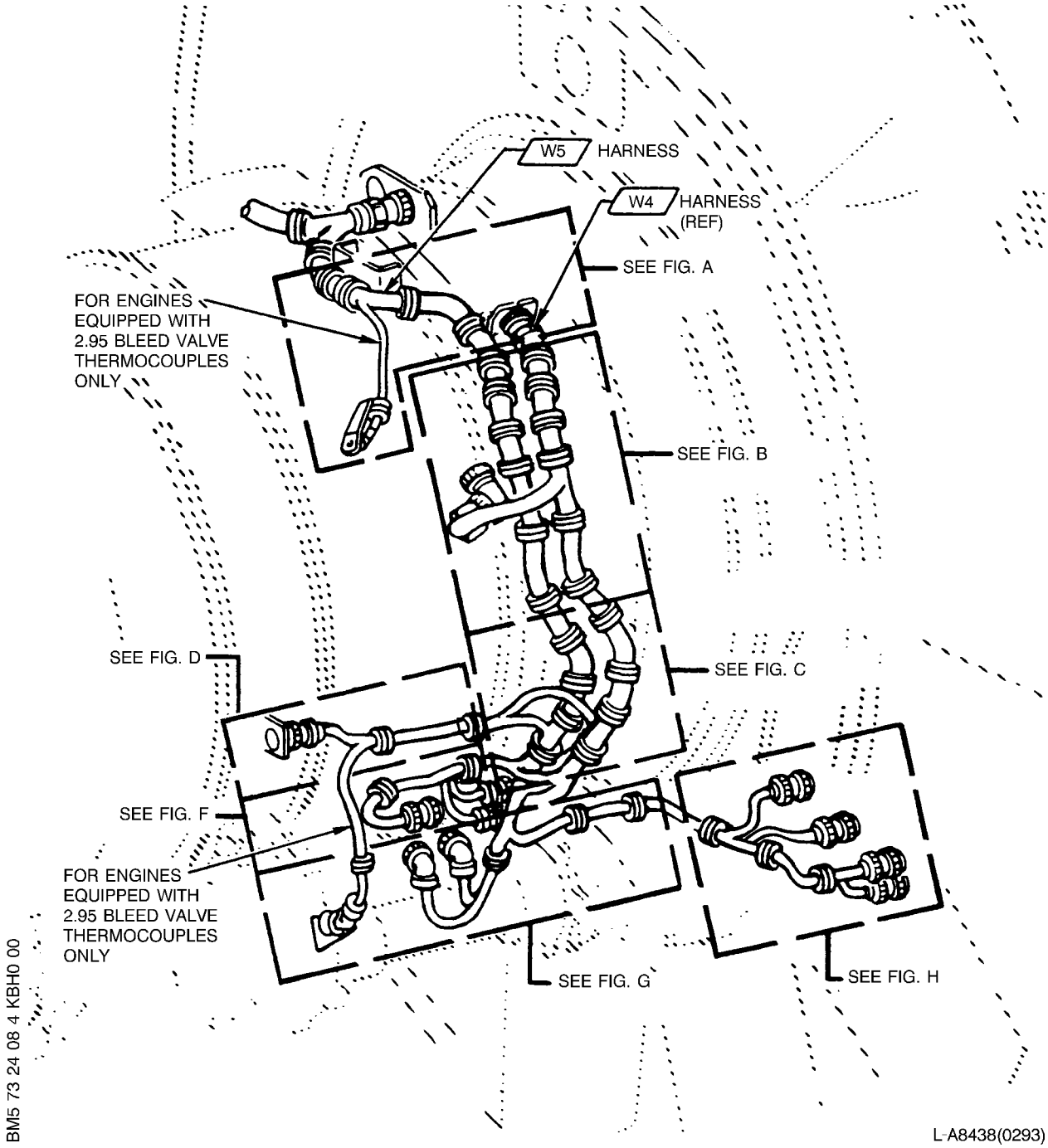


BM5 73 24 08 4 KAF0 00

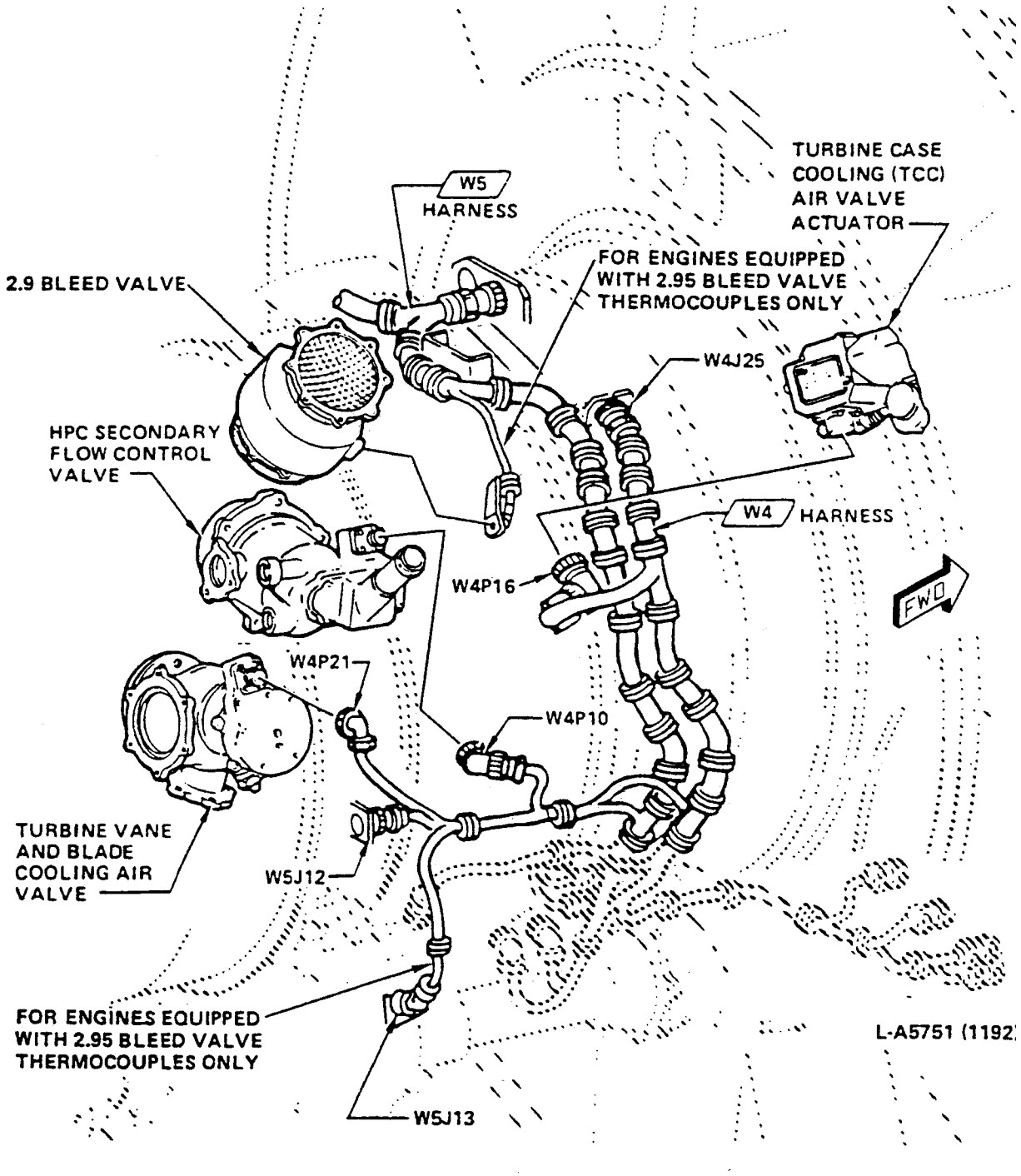
FADEC Core Engine W4 Wiring Harness
Figure 428


W5 HARNESS
W4 HARNESS (REF)
SEE FIG. A
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
SEE FIG. B
SEE FIG. D
SEE FIG. C
SEE FIGS. E AND F
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
SEE FIG. G
SEE FIG. H
BM5 73 24 08 4 KBG0 00
L-A8438(0293)

FADEC Core Engine W4 Wiring Harness
Figure 429

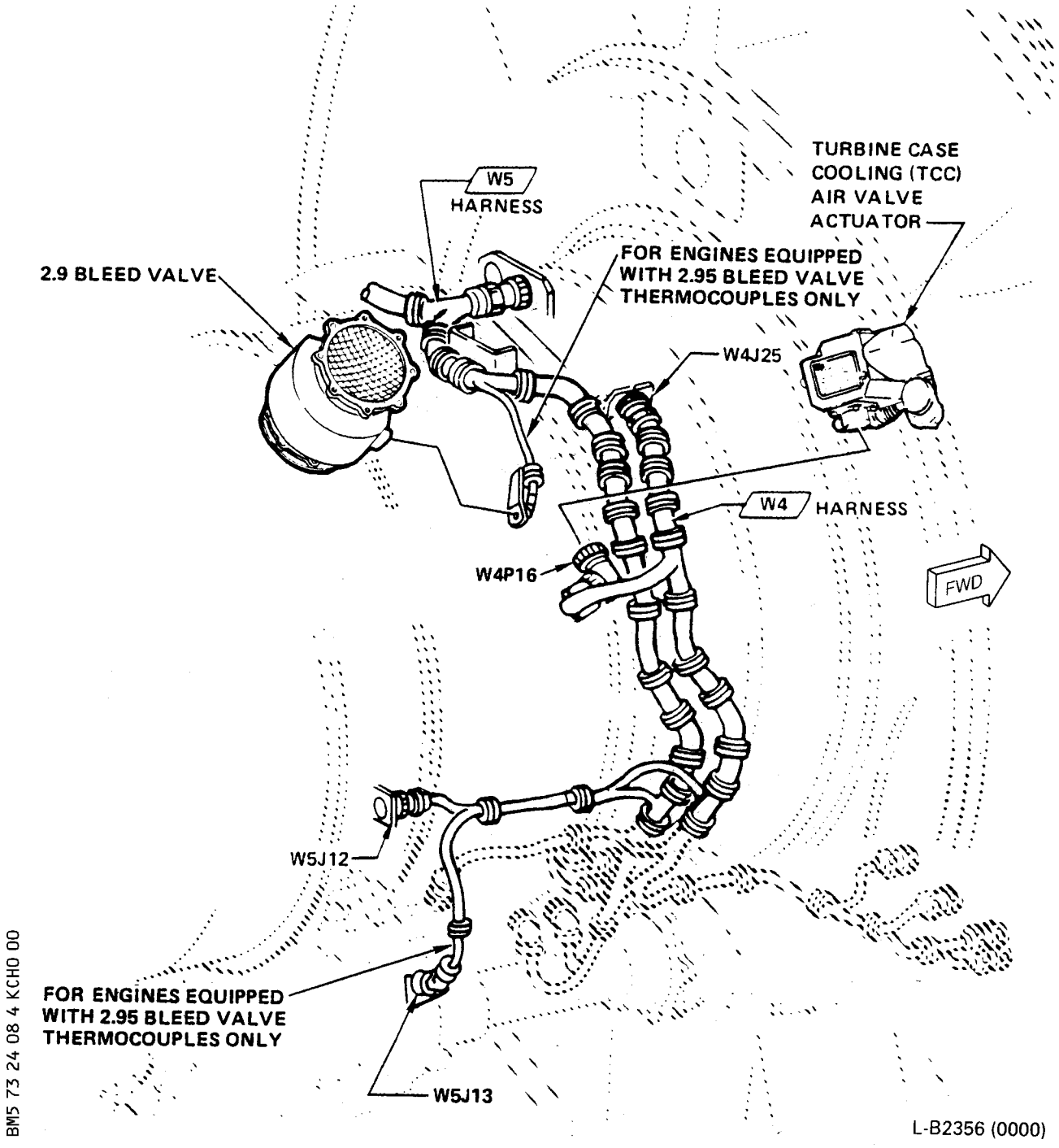

W5 HARNESS
W4 HARNESS (REF)
SEE FIG. A
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
SEE FIG. B
SEE FIG. D
SEE FIG. C
SEE FIG. F
FOR ENGINES EQUIPPED WITH 2.95 BLEED VALVE THERMOCOUPLES ONLY
SEE FIG. G
SEE FIG. H
BM5 73 24 08 4 KBH0 00
L-A8438(0293)

FADEC Core Engine W4 Wiring Harness
Figure 430



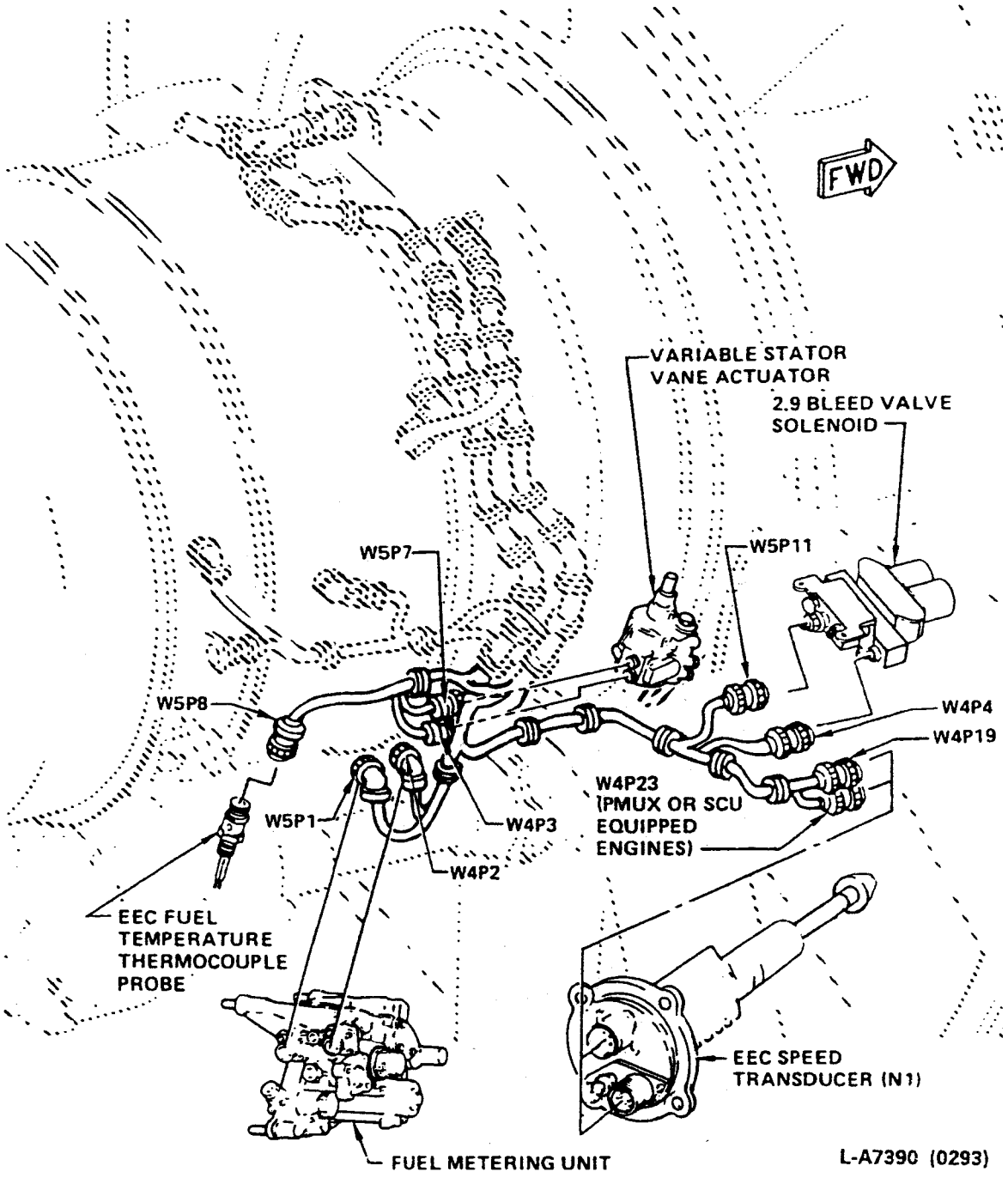
BM5 73 24 08 4 KCG0 00

FADEC Core Engine W4 Wiring Harness - Harness Connectors Location
Figure 431



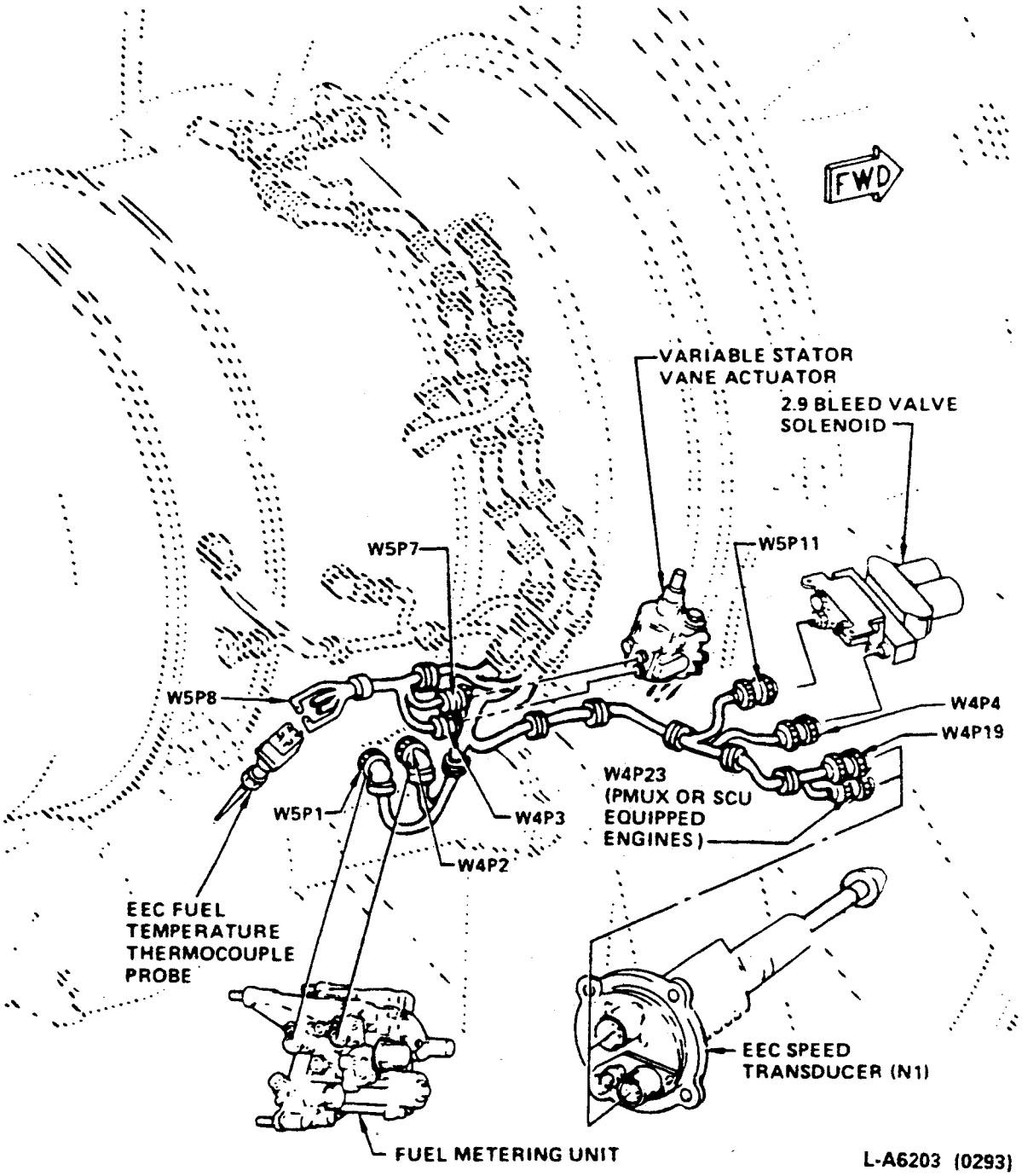
BM5 73 24 08 4 KCH0 00

FADEC Core Engine W4 Wiring Harness - Harness Connectors Location
Figure 432



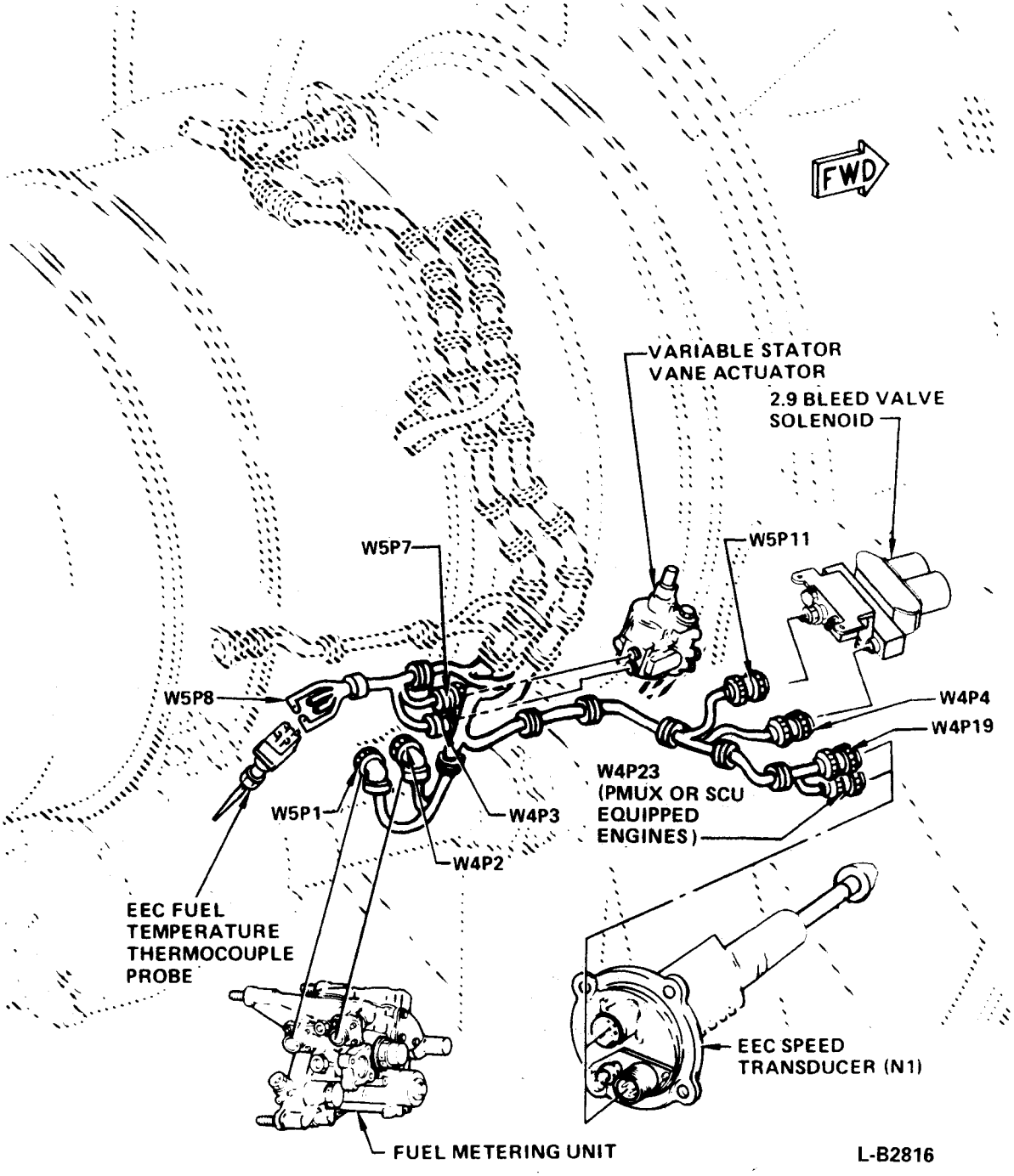
BM5 73 24 08 4 KDF0 00

FADEC Core Engine W4 Wiring Harness - Harness Connectors Location (Pre SB PW4ENG 73-84)
Figure 433



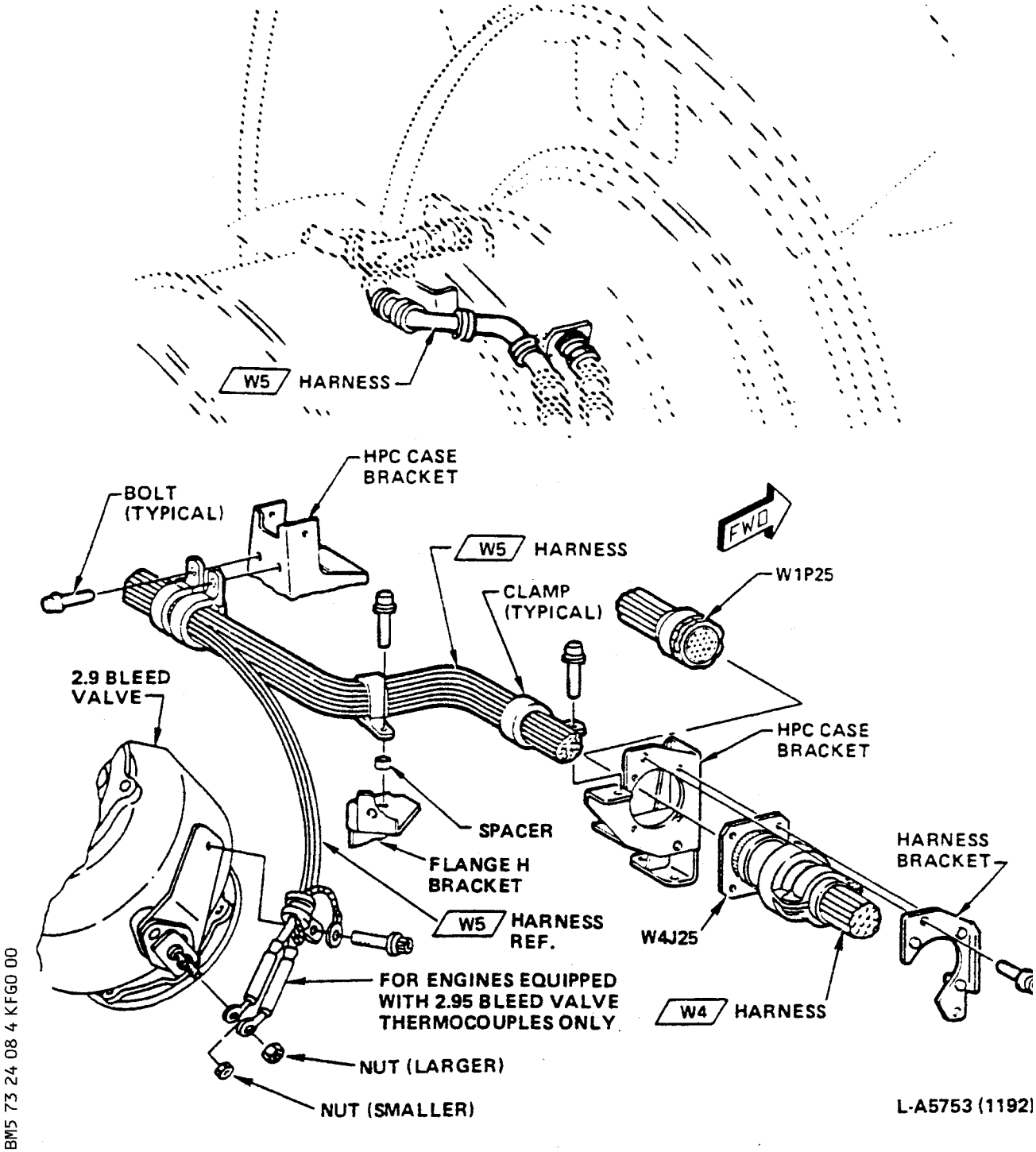
BM5 73 24 08 4 KEF0 00

FADEC Core Engine W4 Wiring Harness - Harness Connectors Location (Post SB PW4ENG 73-84)
Figure 434



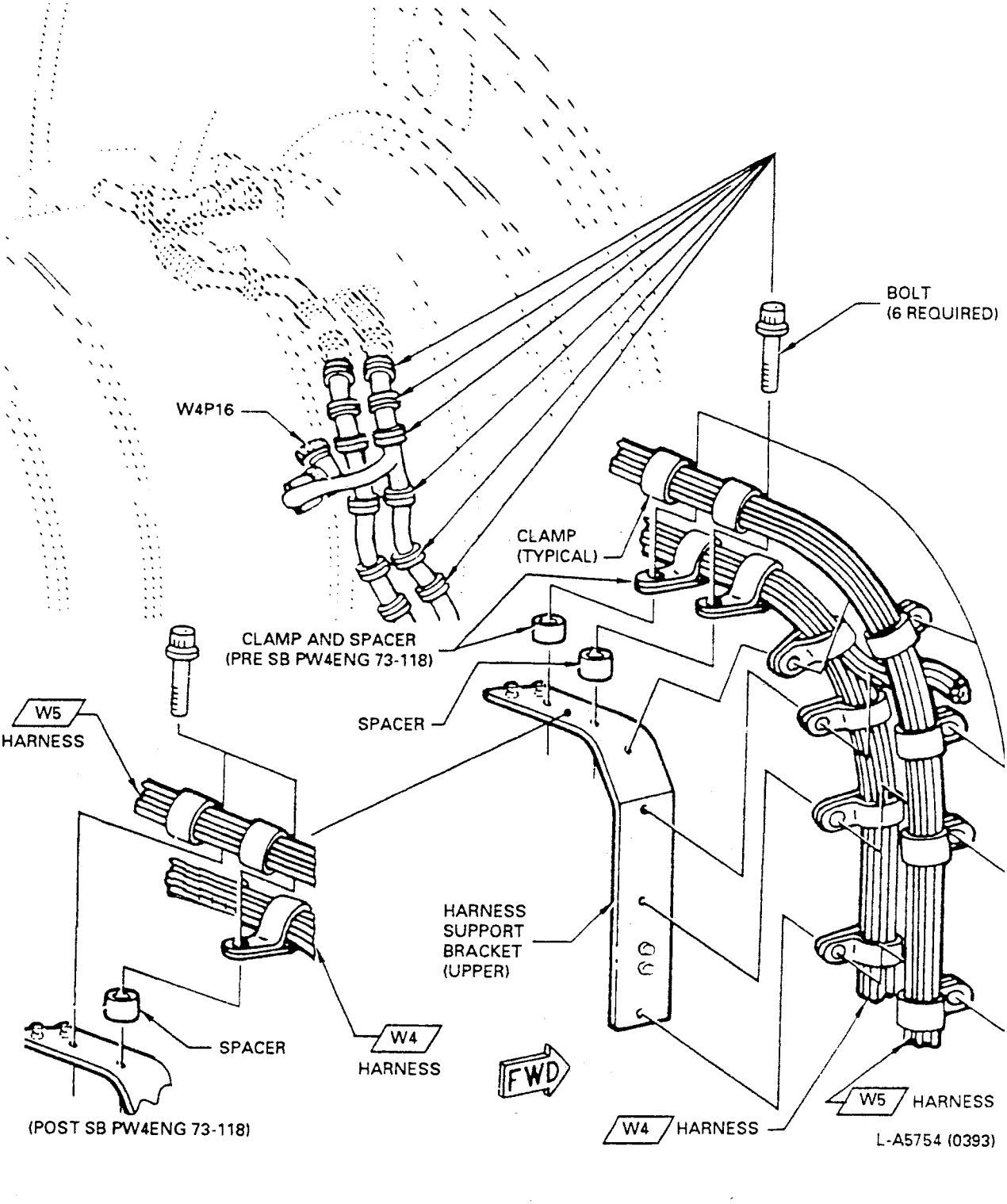
BM5 73 24 08 4 KEH0 00

FADEC Core Engine W4 Wiring Harness - Harness Connectors Location (Post SB PW4ENG 73-84)
Figure 435

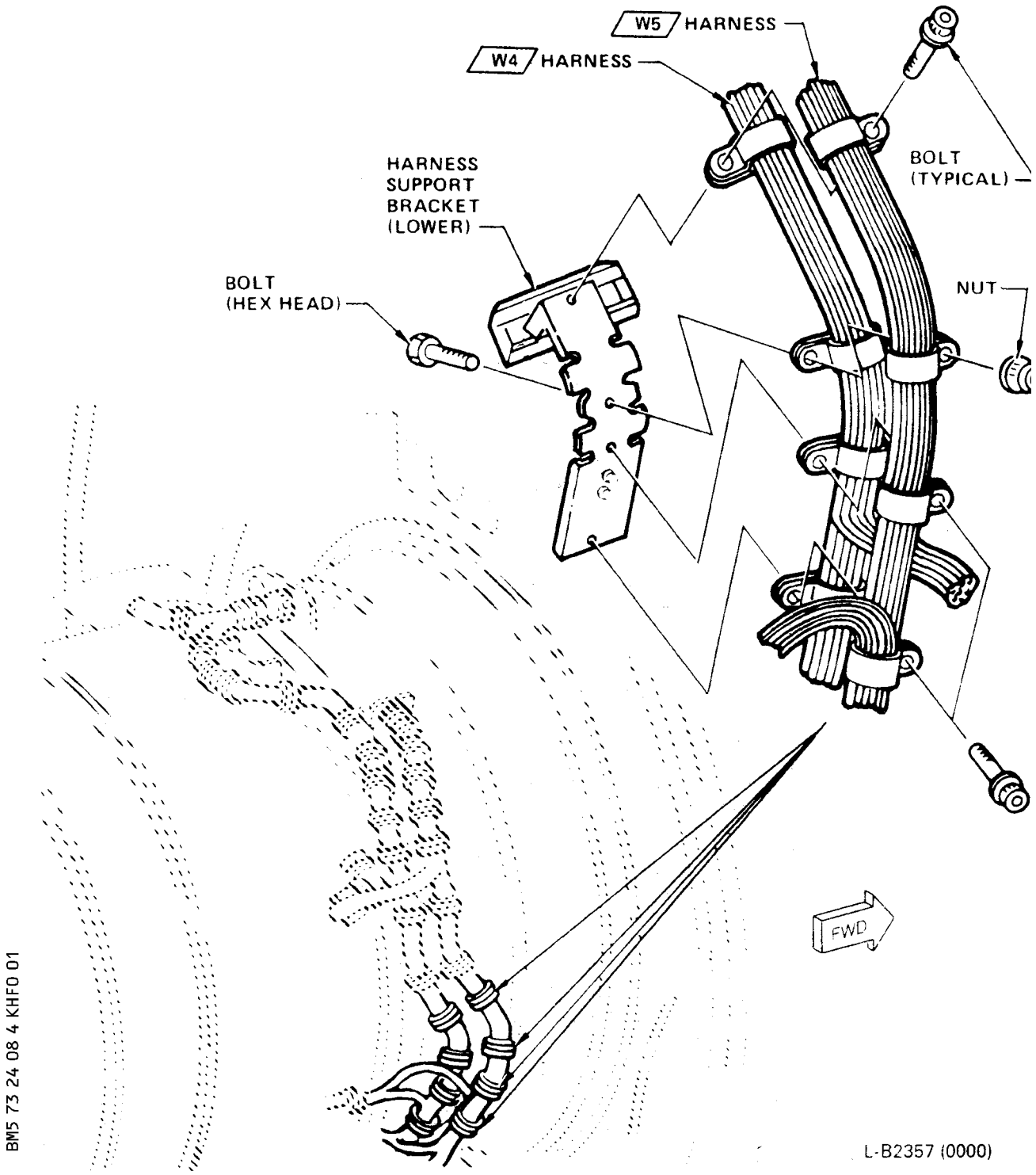


FADEC Core Engine W4 Wiring Harness - Figure A
Figure 436

R

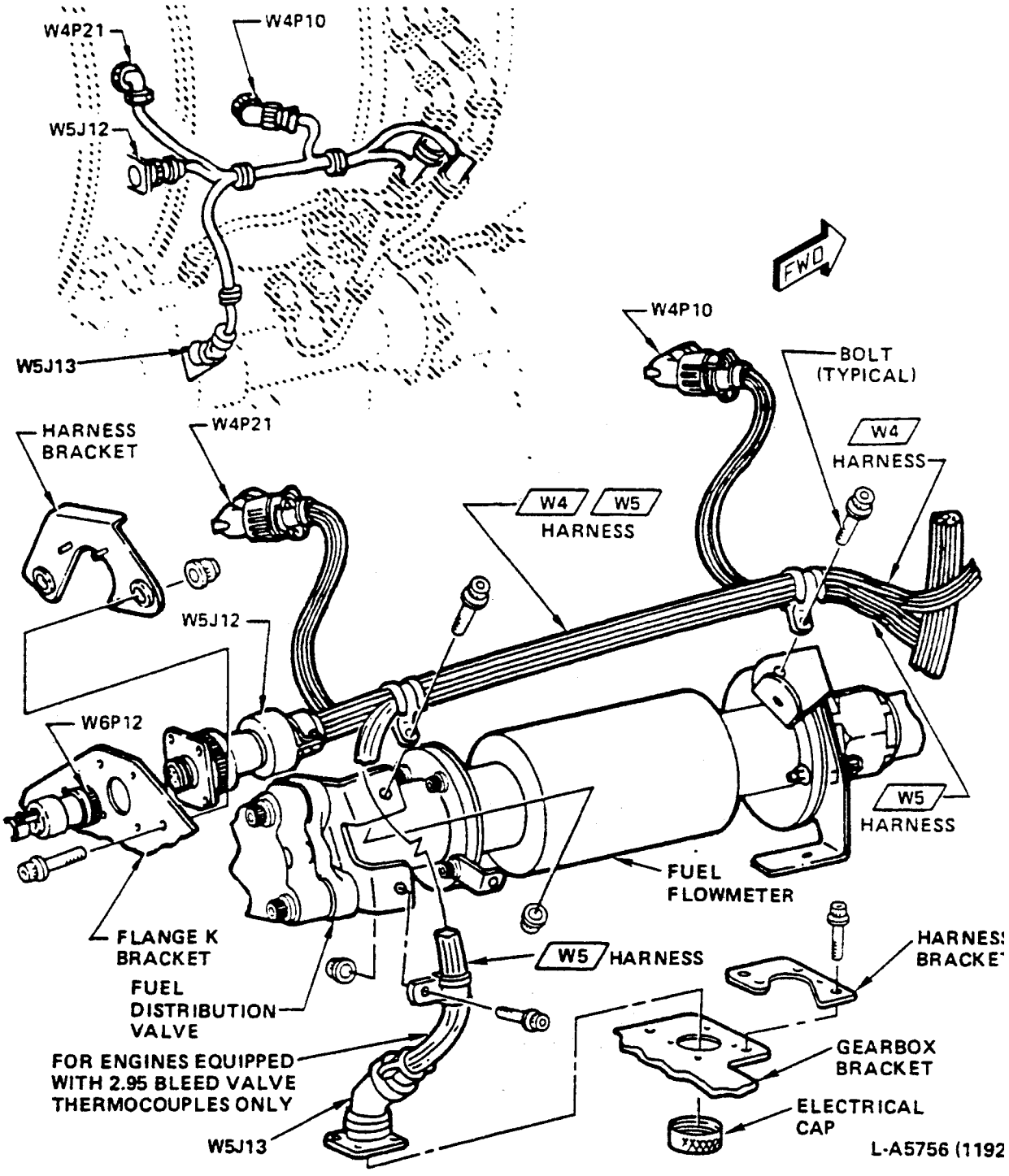


FADEC Core Engine W4 Wiring Harness - Figure B
Figure 437



BM5 73 24 08 4 KHF0 01

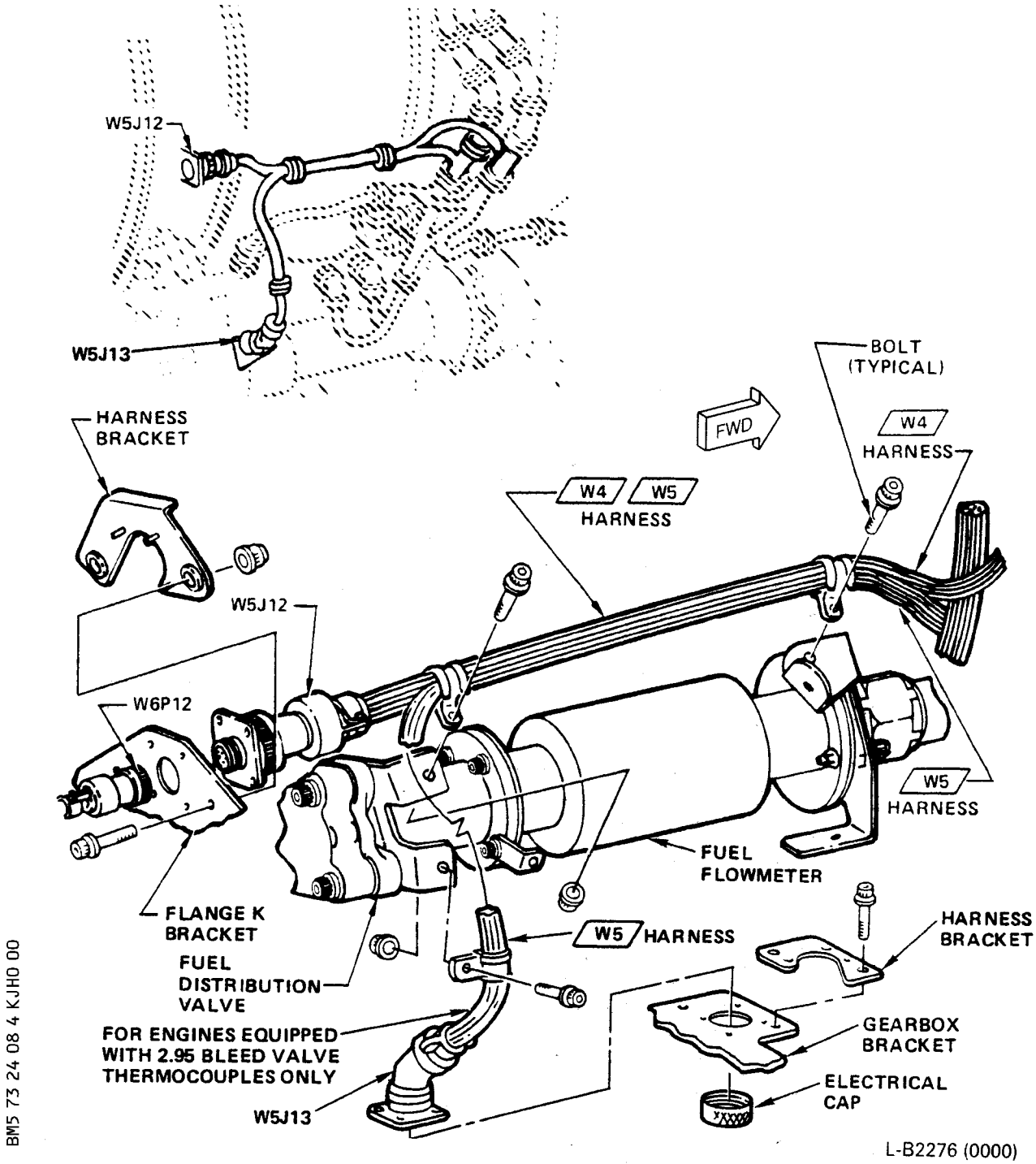
FADEC Core Engine W4 Wiring Harness - Figure C
Figure 438



BM5 73 24 08 4 KJG0 00

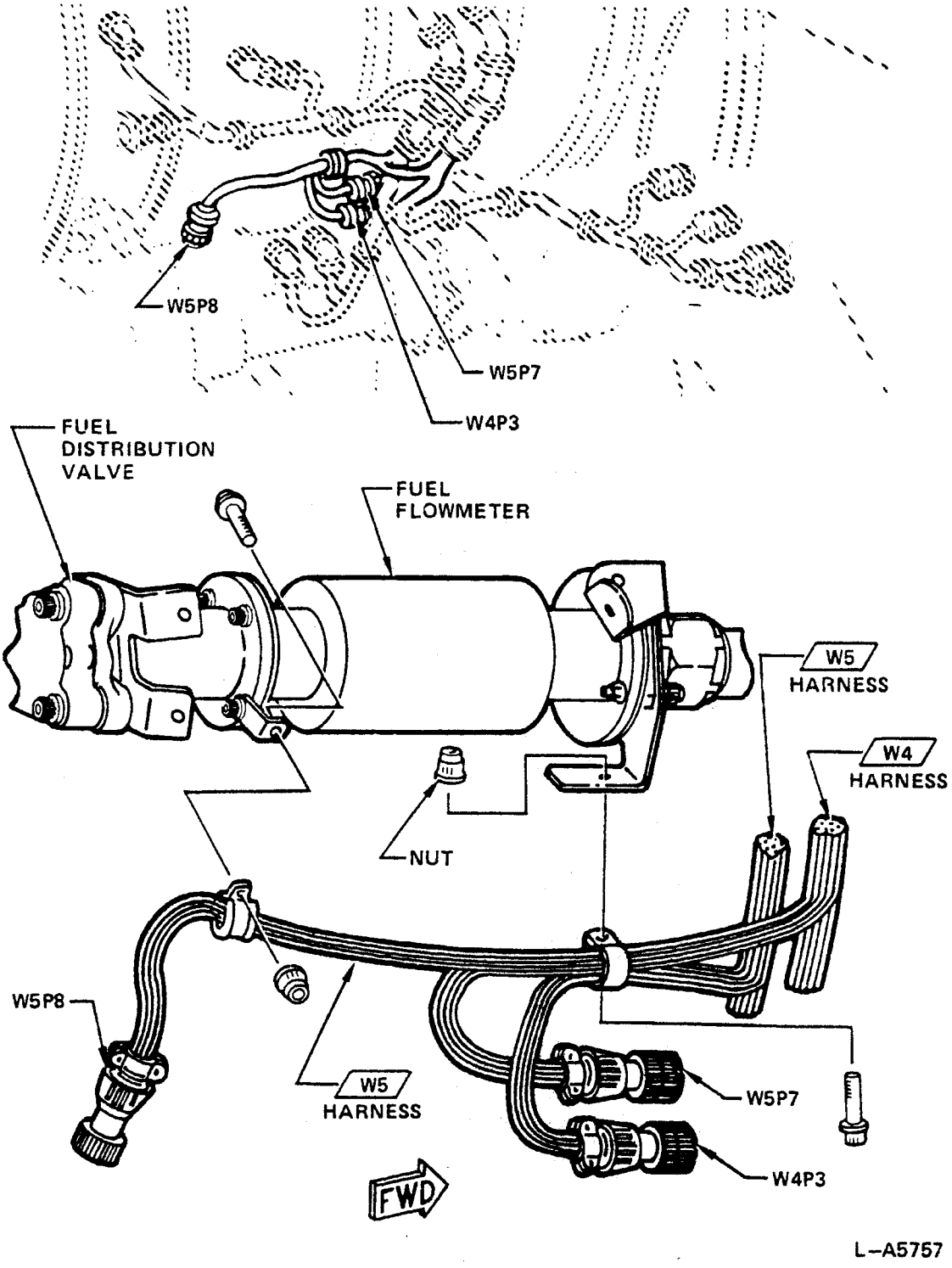
FADEC Core Engine W4 Wiring Harness - Figure D
Figure 439

R



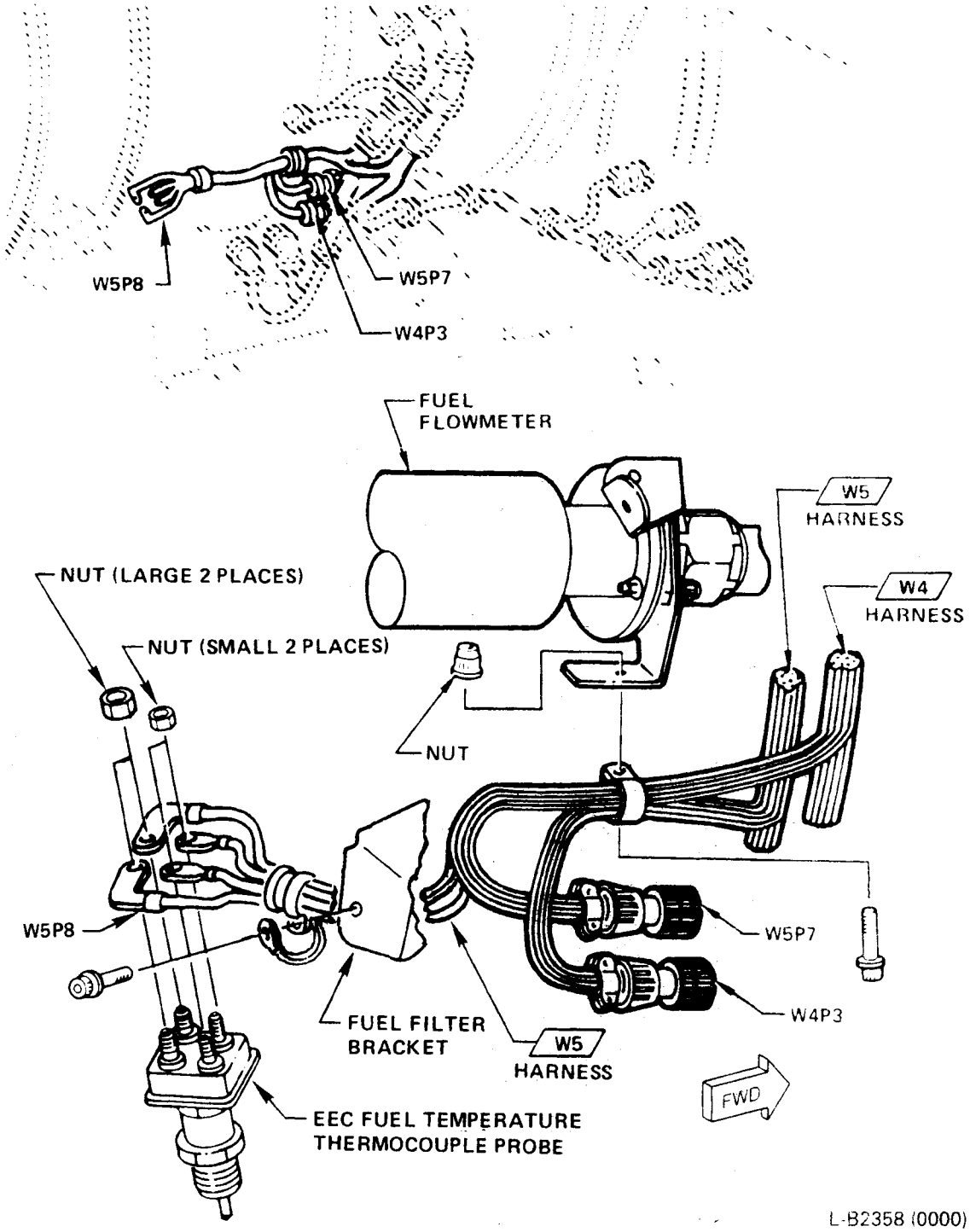
BM5 73 24 08 4 KJH0 00

FADEC Core Engine W4 Wiring Harness - Figure D
Figure 440



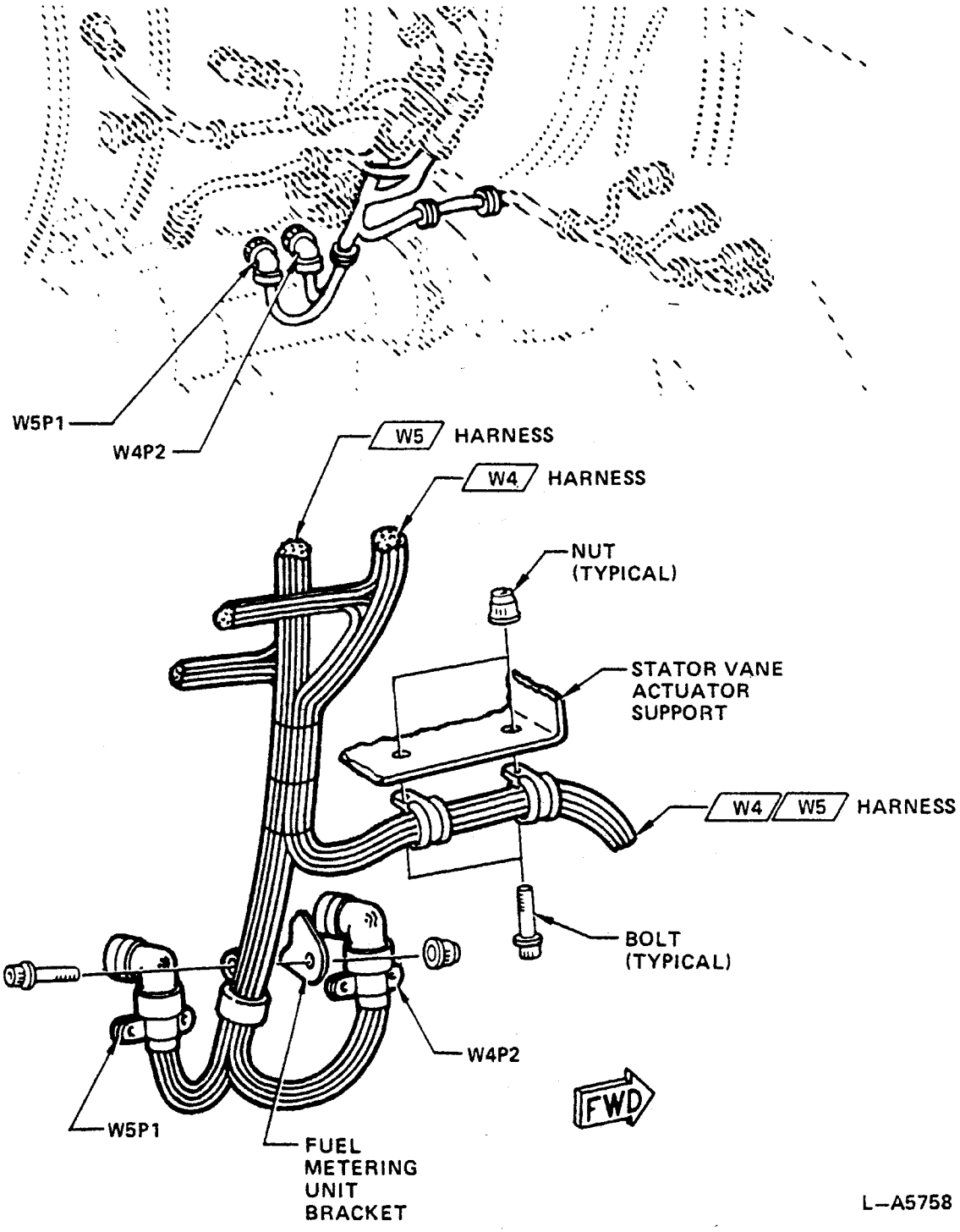
BM5 73 24 08 4 KKF0 00

FADEC Core Engine W4 Wiring Harness
(Pre SB PW4ENG 73-84) - Figure E
Figure 441



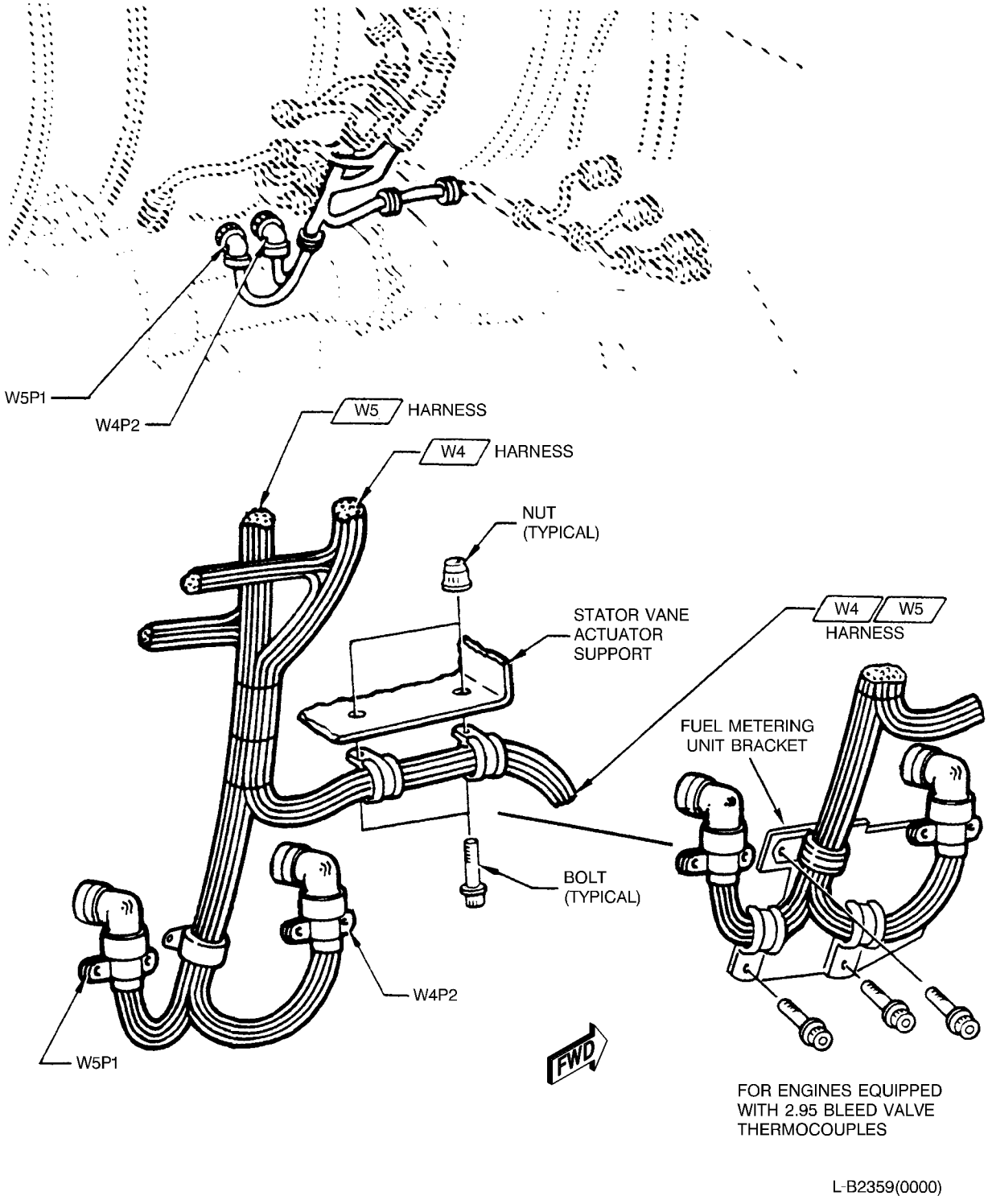
BM5 73 24 08 4 KLF0 01

FADEC Core Engine W4 Wiring Harness
(Post SB PW4ENG 73-84) - Figure F
Figure 442



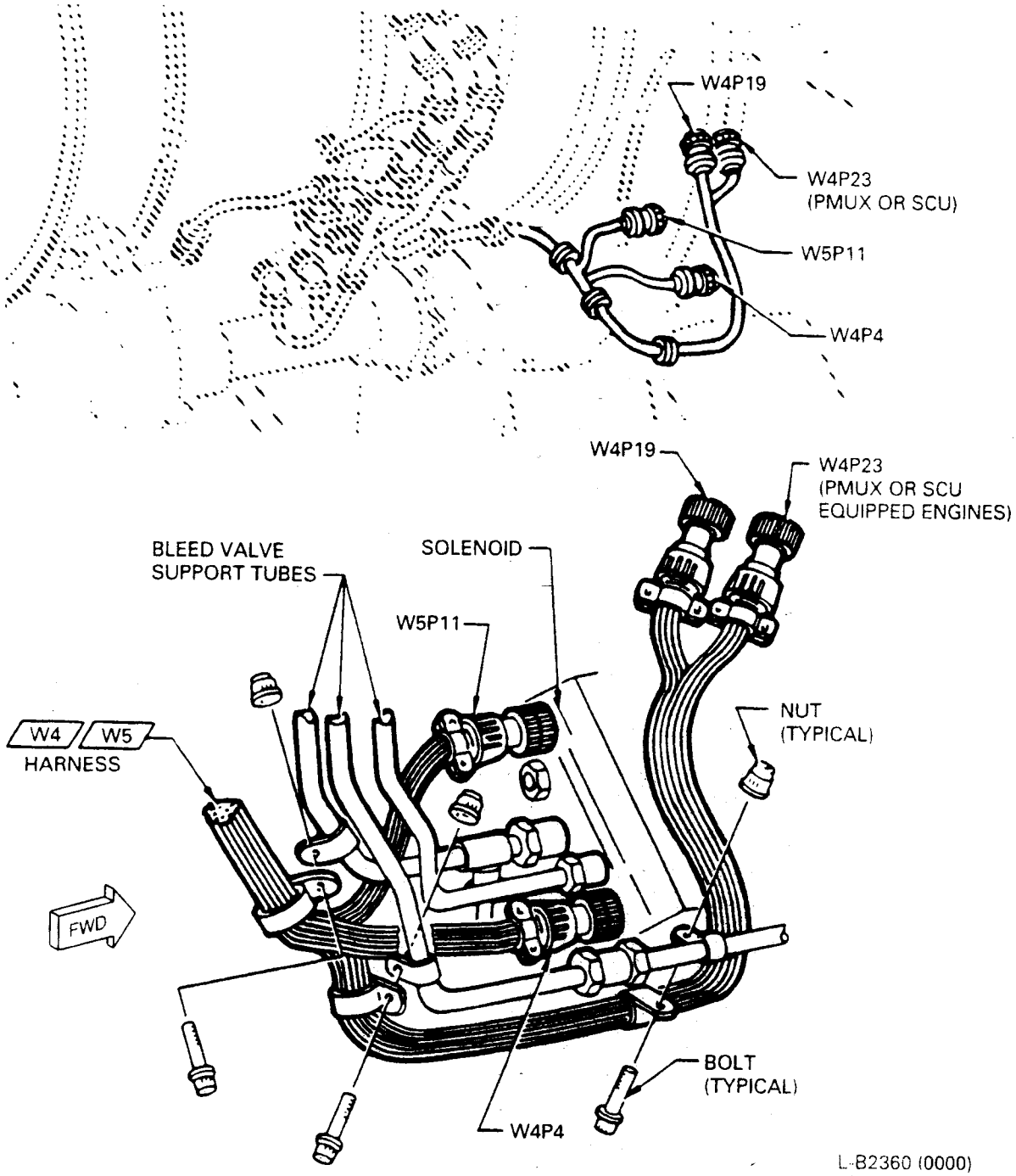
BM5 73 24 08 4 KMF0 00

FADEC Core Engine W4 Wiring Harness - Figure G
Figure 443



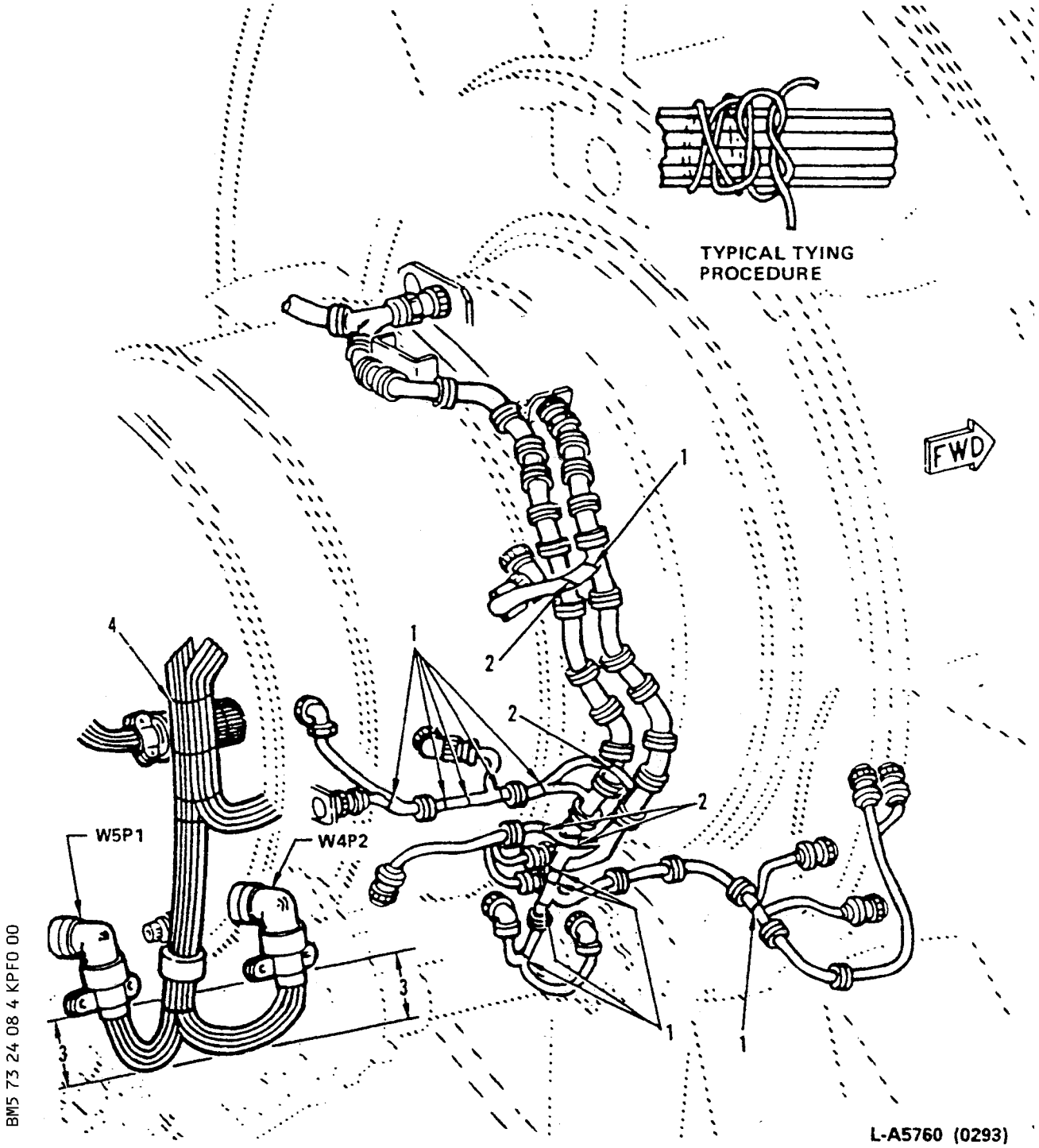
BM5 73 24 08 4 KMG0 00

FADEC Core Engine W4 Wiring Harness - Figure G
Figure 444

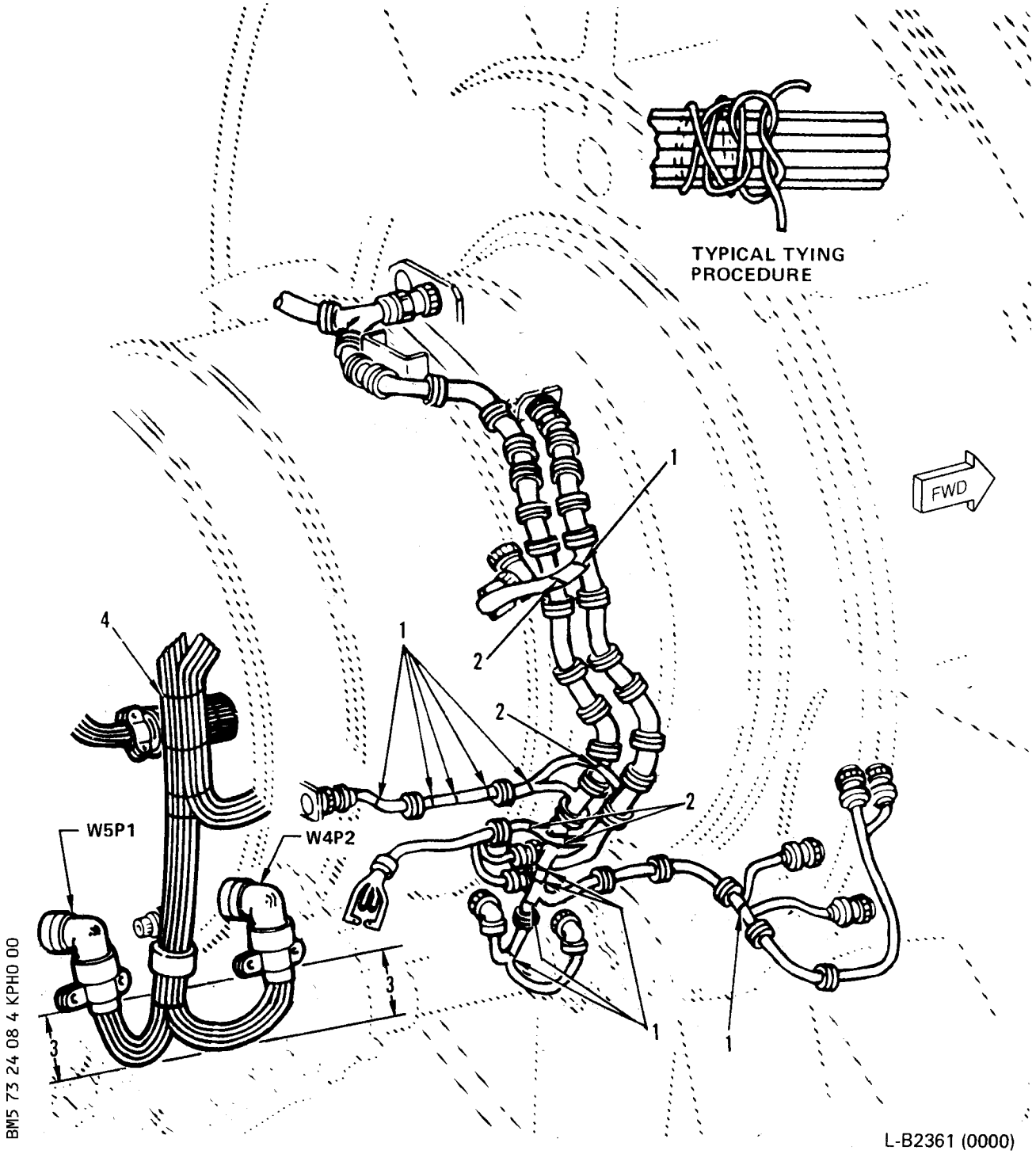


BM5 73 24 08 4 KNF0 01

FADEC Core Engine W4 Wiring Harness - Figure H
Figure 445



FADEC Core Engine W4 Wiring Harness
Figure 446



FADEC Core Engine W4 Wiring Harness
Figure 447

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.A.	19KS	332/U70
133VU	ENGINES - ENG1 FADEC SOLENOIDS CHA.B.	21KS	331/V70
133VU	ENG1 - SCU SUPPLY - GND	35KS	333/T76
133VU	ENG1 - SCU SUPPLY - FLT	37KS	333/T75
Engine 2			
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.A.	18KS	332/U71
133VU	ENGINES - ENG2 FADEC SOLENOIDS CHA.B.	20KS	331/V69
133VU	ENG2 - SCU SUPPLY GND	34KS	333/T85
133VU	ENG2 - SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 428, 408, 410)
(Ref. Fig. 448, 412, 413)
(Ref. Fig. 414, 416, 418)
(Ref. Fig. 419, 422, 423)
(Ref. Fig. 424, 426)
(Ref. Fig. 429, 431, 433)
(Ref. Fig. 434, 436, 437)
(Ref. Fig. 438, 439, 441)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 446)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE REMOVAL, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Disconnect the W2P26 harness connector from the W5J26 harness connector located at the 11:30 o'clock position on the HPC case. (Ref. Fig. 448).
(a)Remove the two bolts and the harness bracket attaching the W5J26 harness connector flange to the HPC case bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.

(2)(Pre SB PW4ENG 73-163) Disconnect the W6P12 harness connector from the W5J12 harness connector located on Flange K at the 3:30 o'clock position. (Ref. Fig. 439).
(a)Remove the two bolts and harness bracket attaching the W5J12 harness connector flange to the Flange K bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.

(3)(Post SB PW4ENG 73-163) Disconnect the W6P12 harness connector from the W5J12 harness connector located on the TCA tube flange bracket at the 3:30 o'clock position as follows :
(a)(Post SB PW4ENG 73-192) Loosen clamp that attaches the cooling hose to the cooling shield around the W5J12 connector. Remove cooling hose from the cooling shield. (Ref. Fig. 449) (Sheet 2/5).
NOTE : Pre SB PW4ENG 73-192 engines do not have W5/W6 wiring harness connector cooling.
(b)(Post SB PW4ENG 73-192) Loosen and remove the clamp attaching the two

halves of the cooling shield around the W5J12 connector. Remove the shields and clamp from the connector.

(c)If necessary, remove or loosen bolt and clamp attaching wiring harness to the loop clamp bracket.

(d)Remove the three bolts and the loop clamp bracket that attach the W5J12 harness connector to the TCA tube flange bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.

(4)Disconnect the following harness connector from the components given below. Install a protective closure on each harness connector and mating receptacle.

R

Connector	Component	Location
W5P10	HPC Secondary Flow Control Valve	9:30 o'clock
W5P5	Fuel/Oil Cooler Bypass Valve Solenoid (Rear Connector)	8 o'clock
W5P6	EEC Alternator (Lower Connector)	Bottom of Gearbox 7 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W5P6 harness connector.		
W5P7	Variable Stator Vane Actuator (Top Connector)	4 o'clock
W5P11	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Inboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W5P11 harness connector.		
W5P1	Fuel Metering Unit (Rear Connector)	Front of Fuel Pump 5 o'clock
W5P8	EEC Fuel	Fuel Pump Housing 4:30 o'clock

(5)Remove the bolts, nuts, and clamps that attach the W5 harness to the brackets and tubes on the HPC case and the gearbox.

(6)Remove the applicable harness ties and carefully remove the W5 harness.

(7)Install protective closures.

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

B. Removal (Ref. Fig. 407, 409, 411)
(Ref. Fig. 448, 412, 413)
(Ref. Fig. 415, 417, 420)
(Ref. Fig. 422, 423, 425)
(Ref. Fig. 427)
(Ref. Fig. 430, 432, 433)
(Ref. Fig. 435, 436, 437)
(Ref. Fig. 438, 440, 441)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 447)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE REMOVAL, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Disconnect the W2P26 harness connector from the W5J26 harness connector located at the 11:30 o'clock position on the HPC case.
(a)Remove the two bolts and the harness bracket attaching the W5J26 harness connector flange to the HPC case bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.
(2)(Pre SB PW4ENG 73-163) Disconnect the W6P12 harness connector from the W5J12 harness connector located on Flange K at the 3:30 o'clock position. (Ref. Fig. 440).
(a)Remove the two bolts and harness bracket attaching the W5J12 harness connector flange to the Flange K bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.
(3)(Post SB PW4ENG 73-163) Disconnect the W6P12 harness connector from the W5J12 harness connector located on the TCA tube flange bracket at the 3:30 o'clock position as follows :
(a)(Post SB PW4ENG 73-192) Loosen clamp that attaches the cooling hose to the cooling shield around the W5J12 connector. Remove cooling hose from the cooling shield. (Ref. Fig. 449) (Sheet 2/5).
NOTE : Pre SB PW4ENG 73-192 engines do not have W5/W6 wiring harness connector cooling.
(b)(Post SB PW4ENG 73-192) Loosen and remove the clamp attaching the two halves of the cooling shield around the W5J12 connector. Remove the shields and clamp from the connector.
(c)If necessary, remove or loosen bolt and clamp attaching wiring harness to the loop clamp bracket.
(d)Remove the three bolts and the loop clamp bracket that attach the W5J12 harness connector to the TCA tube flange bracket. Remove the connector from the bracket. Install a protective closure on each harness connector.
(4)Disconnect the following harness connector from the components given below. Install a protective closure on each harness connector and

mating receptacle.

Connector	Component	Location
W5P5	Fuel/Oil Cooler Bypass Valve Solenoid (Rear Connector)	8 o'clock
W5P6	EEC Alternator (Lower Connector)	Bottom of Gearbox 7 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W5P6 harness connector.		
W5P7	Variable Stator Vane Actuator (Top Connector)	4 o'clock
W5P11	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Inboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to disconnect the W5P11 harness connector.		
W5P1	Fuel Metering Unit (Rear Connector)	Front of Fuel Pump 5 o'clock
W5P8	EEC Fuel	Fuel Pump Housing 4:30 o'clock

(5)Remove the bolts, nuts, and clamps that attach the W5 harness to the brackets and tubes on the HPC case and the gearbox.
(6)Remove the applicable harness ties and carefully remove the W5 harness.
(7)Install protective closures.

**ON A/C 101-200,

C. Installation (Ref. Fig. 428, 408, 410)
(Ref. Fig. 448, 412, 413)
(Ref. Fig. 414, 416, 418)
(Ref. Fig. 419, 422, 423)
(Ref. Fig. 424, 426)
(Ref. Fig. 429, 431, 433)
(Ref. Fig. 434, 436, 437)
(Ref. Fig. 438, 439, 441)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 446)
CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE

INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Install the W5 harness on the left and right sides of the engine.

(a)Remove the protective closure. Install the W5J26 connector flange to the HPC case bracket located at the 11:30 o'clock position. Attach the connector flange to the bracket temporarily with lockwire. (Ref. Fig. 448).

(b)Place the leg of the harness with the connectors W5P1, W5P7, W5P8, W5P11, and W5J12 over the top of the HPC case and down the right side of the engine.

(c)Remove the lockwire securing the W5J26 connector flange to the HPC case bracket. Install the harness bracket (cut-out up) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(2)(Pre SB PW4ENG 73-163) Remove the protective closures. Install the W5J12 connector flange to the Flange K bracket at the 3:30 o'clock position. Install the harness bracket (angle forward with cut-out inboard) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Engine Oil (P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(Ref. Fig. 439).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

CAUTION : MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(3)(Post SB PW4ENG 73-163) Remove the protective closures. Align the W5J12 connector to the TCA tube flange bracket. Position the connector in the bracket so that the master keyway is located at an outboard location at approximately 30 degrees above the horizontal center line. Secure the connector to the TCA tube flange bracket with the loop clamp bracket and three bolts, threads lubricated with Engine Oil (P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(Ref. Fig. 449).

(a)(Post SB PW4ENG 73-192) Install cooling shields around the W5 harness connector as follows :

NOTE : Pre SB PW4ENG 73-192 engines do not have W5/W6 wiring harness connector cooling.

1 Position the cooling shields around the W5 harness connector W5J12 and slide the cooling shield tabs into loop clamp bracket. Make sure the shield with the hose fitting is on the bottom.

2 Install hose clamps around the cooling shields. TORQUE the hose clamps to between 10 and 15 lbf.in. (0.11 and 0.17 m.daN).

3 Install the cooling hose and clamp onto the bottom cooling shield fitting. TORQUE the hose clamp to between 10 and 15 lbf.in. (0.11 and 0.17 m.daN).

5 If removed or loosened, install the clamp and bolt attaching the wiring harness to the loop clamp bracket. Lubricate bolt threads with Engine Oil (P03-001). TORQUE the bolts to between 36 and 40 lbf.in.

(0.40 and 0.45 m.daN).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

CAUTION : MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(4)Remove the protective closures. Connect the W5P10 harness connector to the HPC secondary flow control valve located at the 9:30 o'clock position.

(a)Tighten and TORQUE the connector to between 21 and 26 lbf.in. (0.24 and 0.29 m.daN). Wirelock the connector nut with AS3214-01.

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

(5)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

R	Connector	Component	Location
	W5P8	EEC Fuel Temperature Thermocouple (Pre SB PW4ENG 73-84)	Fuel Pump Housing 4:30 o'clock
	W5P1	Fuel Metering Unit (Rear Connector)	Front of Fuel Pump 5 o'clock
	W5P11	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Inboard Connector)	Intermediate Case 5 o'clock
	NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W5P11 harness connector.		
	W5P7	Variable Stator Vane Actuator (Top Connector)	4 o'clock
	W5P6	EEC Alternator (Lower Connector)	Bottom of Gearbox 7 o'clock
	NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W5P6 harness connector.		

	Connector	Component	Location
	W5P5	Fuel/Oil Cooler Bypass Valve Solenoid (Rear Connector)	8 o'clock
	W2P26	Harness Connector to W5J26 Harness Connector	11:30 o'clock
	W6P12	Harness Connector to W5J12 Harness Connector	3:30 o'clock

(6)(Post SB PW4ENG 73-84) For a thermocouple probe (EEC Oil Temperature, and EEC Fuel Temperature, 2.95 Bleed Valve) with a studded terminal type receptacle install the wiring harness as follows.

(a)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.

(b)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(c)If necessary to align the thermocouple stud box, remove the lockwire from the thermocouple coupling nut to the adapter and loosen the coupling nut.

(d)Align the thermocouple stud box with the wiring harness connector.

(e)Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.

CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.

(f)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.

CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.

(g)TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).

(h)TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).

(i)Install lockwire from the coupling nut to the adapter.

(j)TORQUE the bolt that attaches the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(7)Adjust the W5 harness for any necessary clearances as required. Install the clamps at all clamp points. Refer to the figures. Attach the clamps loosely to the engine with bolts and/or nuts, threads lubricated with Material No.P03-001.

NOTE : Use different clamp sizes on the harnesses to prevent harness movement when tightened. See the Illustrated Parts Catalog for selection of the clamp sizes and part numbers.

(8)Make sure that the harnesses are not tight to the point where sharp bends are caused, and that the harnesses do not touch any engine parts or plumbing. Provide a drip loop on the leads where the wires run downward into the connector.

(9)TORQUE all the previously installed clamp nuts and/or bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(10)Tie the harnesses as shown (Ref. Fig. 424, 426, 446).

NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown. The clove hitch and square knot must be tightened satisfactorily in place.
The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled. Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

C. Installation (Ref. Fig. 407, 409, 411)
(Ref. Fig. 448, 412, 413)
(Ref. Fig. 415, 417, 420)
(Ref. Fig. 422, 423, 425)
(Ref. Fig. 427)
(Ref. Fig. 430, 432, 433)
(Ref. Fig. 435, 436, 437)
(Ref. Fig. 438, 440,)
(Ref. Fig. 442, 444, 445)
(Ref. Fig. 447)

CAUTION : DO NOT TWIST OR BEND THE HARNESS BADLY DURING THE INSTALLATION, OR DAMAGE TO THE HARNESS CAN OCCUR.

(1)Install the W5 harness on the left and right sides of the engine.

(a)Remove the protective closure. Install the W5J26 connector flange to the HPC case bracket located at the 11:30 o'clock position. Attach the connector flange to the bracket temporarily with lockwire.

(b)Place the leg of the harness with the connectors W5P1, W5P7, W5P8, W5P11, and W5J12 over the top of the HPC case and down the right side of the engine.

(c)Remove the lockwire securing the W5J26 connector flange to the HPC case bracket. Install the harness bracket (cut-out up) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Material No.P03-001. TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(2)(Pre SB PW4ENG 73-163) Remove the protective closures. Install the W5J12 connector flange to the Flange K bracket at the 3:30 o'clock position. Install the harness bracket (angle forward with cut-out inboard) to attach the connector flange between the two brackets. Align the bolt holes and install the bolts, threads lubricated with Engine Oil

(P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(Ref. Fig. 440).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

CAUTION : MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(3)(Post SB PW4ENG 73-163) Remove the protective closures. Align the W5J12 connector to the TCA tube flange bracket. Position the connector in the bracket so that the master keyway is located at an outboard location at approximately 30 degrees above the horizontal center line. Secure the connector to the TCA tube flange bracket with the loop clamp bracket and three bolts, threads lubricated with Engine Oil (P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(Ref. Fig. 449).

(a)(Post SB PW4ENG 73-192) Install cooling shields around the W5 harness connector as follows :

NOTE : Pre SB PW4ENG 73-192 engines do not have W5/W6 wiring harness connector cooling.

1 Position the cooling shields around the W5 harness connector W5J12 and slide the cooling shield tabs into loop clamp bracket. Make sure the shield with the hose fitting is on the bottom.

2 Install hose clamps around the cooling shields. TORQUE the hose clamps to between 10 and 15 lbf.in. (0.11 and 0.17 m.daN).

3 Install the cooling hose and clamp onto the bottom cooling shield fitting. TORQUE the hose clamp to between 10 and 15 lbf.in. (0.11 and 0.17 m.daN).

5 If removed or loosened, install the clamp and bolt attaching the wiring harness to the loop clamp bracket. Lubricate bolt threads with Engine Oil (P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN).

CAUTION : EXAMINE THE HARNESS CONNECTORS AND THE MATING RECEPTACLES FOR BENT PINS AND CONTAMINATION. CAREFULLY MAKE STRAIGHT ANY BENT PINS AND CLEAN AS REQUIRED.

CAUTION : MAKE SURE THE SPECIFIED TORQUE WRENCH READING IS OBEYED. INCORRECT CONNECTOR TORQUE COULD CAUSE CONNECTOR DAMAGE AND INADEQUATE LIGHTENING PROTECTION.

(4)Remove the protective closures. Connect the following harness connectors to the components and to the mating harness receptacles given below.

CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

Connector	Component	Location

Connector	Component	Location
W5P8	EEC Fuel Temperature Thermocouple (Pre SB PW4ENG 73-84)	Fuel Pump Housing 4:30 o'clock
W5P1	Fuel Metering Unit (Rear Connector)	Front of Fuel Pump 5 o'clock
W5P11	Ninth Stage Start/Stability (2.9) Bleed Valve Solenoid (Inboard Connector)	Intermediate Case 5 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W5P11 harness connector.		
W5P7	Variable Stator Vane Actuator (Top Connector)	4 o'clock
W5P6	EEC Alternator (Lower Connector)	Bottom of Gearbox 7 o'clock
NOTE : Use a PWA 85749 Electronic Harness Connector Torque Adapter to tighten the W5P6 harness connector.		
W5P5	Fuel/Oil Cooler Bypass Valve Solenoid (Rear Connector)	8 o'clock
W2P26	Harness Connector to W5J26 Harness Connector	11:30 o'clock
W6P12	Harness Connector to W5J12 Harness Connector	3:30 o'clock

(5)(Post SB PW4ENG 73-84) For a thermocouple probe (EEC Oil Temperature, and EEC Fuel Temperature, 2.95 Bleed Valve) with a studded terminal type receptacle install the wiring harness as follows.

(a)Install the wiring harness terminals to the thermocouple studs and install loosely the nuts to the thermocouple studs.

(b)Install the clamp, ground strap, and bolt loosely to the bracket on the housing.

CAUTION : TO PREVENT DAMAGE TO THE WIRING HARNESS, MAKE SURE THE THERMOCOUPLE STUD BOX DOES NOT TURN WHEN THE COUPLING NUT IS TORQUED.

(c)If necessary to align the thermocouple stud box, remove the lockwire from the thermocouple coupling nut to the adapter and loosen the coupling nut.

(d)Align the thermocouple stud box with the wiring harness connector.

(e)Hold the thermocouple stud box and TORQUE the thermocouple probe coupling nut to between 95 and 100 lbf.in. (1.07 and 1.13 m.daN). Do not let the thermocouple studs turn.
CAUTION : DO NOT ALIGN THE THERMOCOUPLE STUD BOX AFTER THE COUPLING NUT IS TORQUED. HOLD THE THERMOCOUPLE STUD BOX AND LOOSEN THE COUPLING NUT AND ALIGN THE THERMOCOUPLE STUD BOX AGAIN.
(f)Make sure the thermocouple stud box is aligned. Do not put too much force on the terminals of the wiring harness.
CAUTION : TOO MUCH TORQUE (MORE THAN MAXIMUM TORQUE) ON THE THERMOCOUPLE NUTS CAN LOOSEN OR DAMAGE THE THERMOCOUPLE STUDS.
(g)TORQUE the alumel nuts (larger terminal studs) to between 18 and 22 lbf.in. (0.20 and 0.25 m.daN).
(h)TORQUE the chromel nuts (smaller terminal studs) to between 15 and 18 lbf.in. (0.17 and 0.20 m.daN).
(i)Install lockwire from the coupling nut to the adapter.
(j)TORQUE the bolt that attaches the clamp and ground strap to the bracket on the housing to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(6)Adjust the W5 harness for any necessary clearances as required. Install the clamps at all clamp points.
Refer to the figures. Attach the clamps loosely to the engine with bolts and/or nuts, threads lubricated with Material No.P03-001.
NOTE : Use different clamp sizes on the harnesses to prevent harness movement when tightened. See the Illustrated Parts Catalog for selection of the clamp sizes and part numbers.

(7)Make sure that the harnesses are not tight to the point where sharp bends are caused, and that the harnesses do not touch any engine parts or plumbing. Provide a drip loop on the leads where the wires run downward into the connector.

(8)TORQUE all the previously installed clamp nuts and/or bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

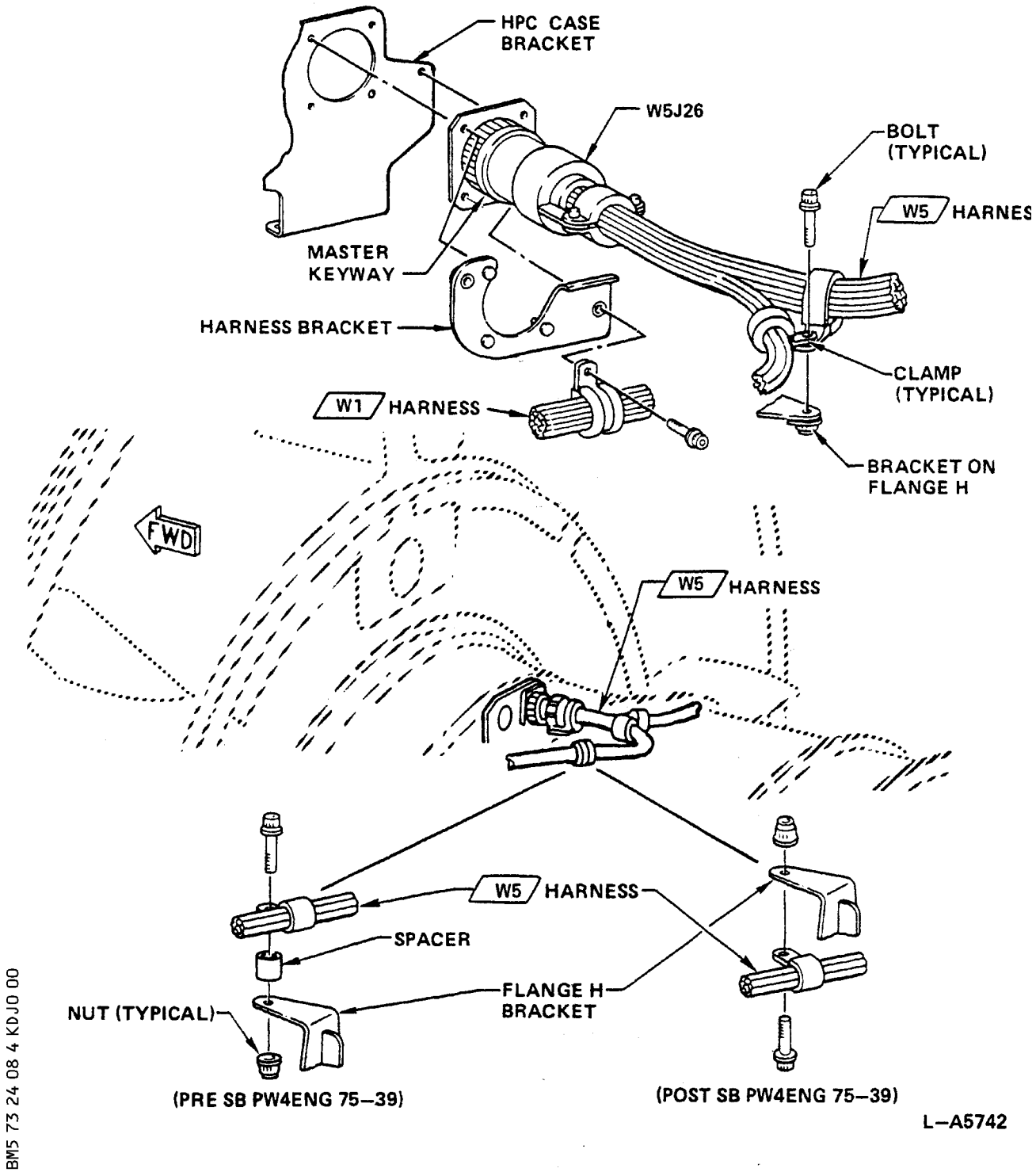
(9)Tie the harnesses as shown (Ref. Fig. 425, 427, 447).
NOTE : Ties must be made with a clove hitch with an extra loop, followed by a square knot, as shown. The clove hitch and square knot must be tightened satisfactorily in place.
The harnesses must not be stressed or damaged by overtightening the ties. Where the harness bundles are more than 1.50 in. (38.10 mm) in diameter, the lacing tape must be doubled. Cut the ends of the lacing tape to a length of 0.25 - 0.50 in. (6.35 - 12.70 mm).

**ON A/C 101-200,

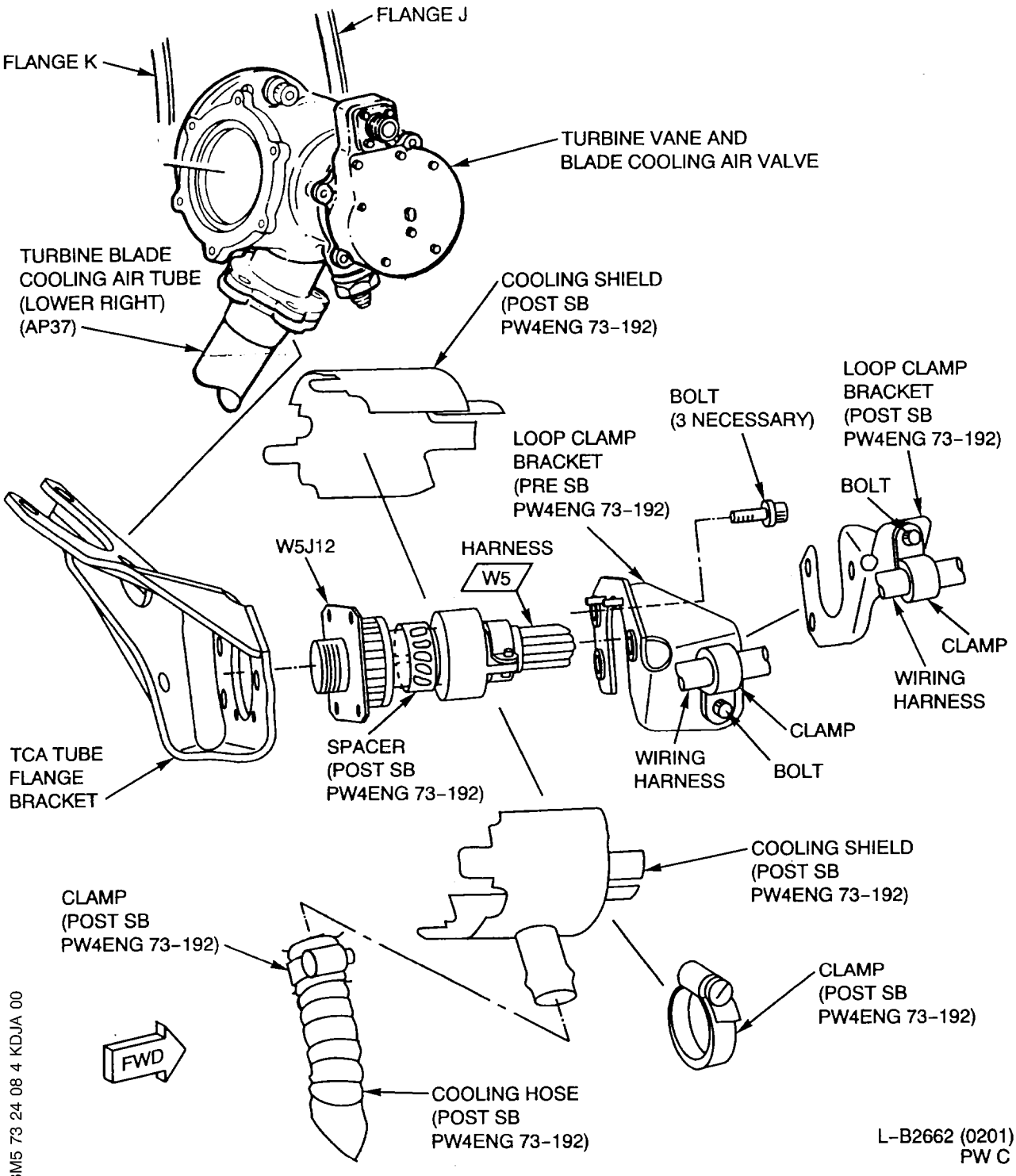
D. CLose-Up
(1)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(2)Remove safety clips and tags and close circuit breakers : 18KS, 19KS, 20KS, 21KS, 34KS, 35KS, 36KS, 37KS.

EEC WIRING HARNESS - REMOVAL/INSTALLATION

1. Remove EEC Fan Case Wiring Harnesses W1 and W2 For Engines Without a Supplemental Control Unit (SCU)

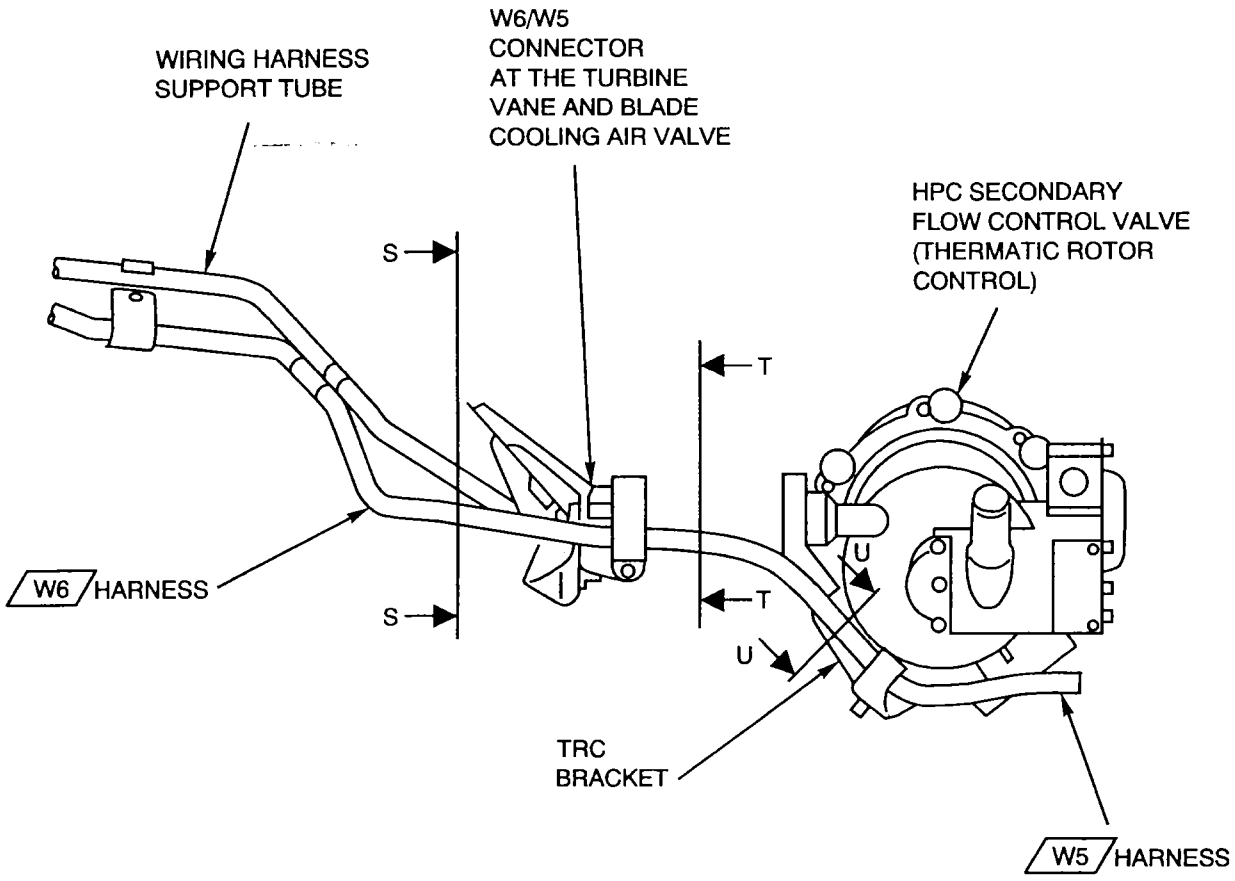


FADEC Core Engine W5 Wiring Harness
Figure 448



FADEC Core Engine W5 Wiring Harness Sheet 1/5
(Post SB PW4ENG 73-163)
Figure 449

R

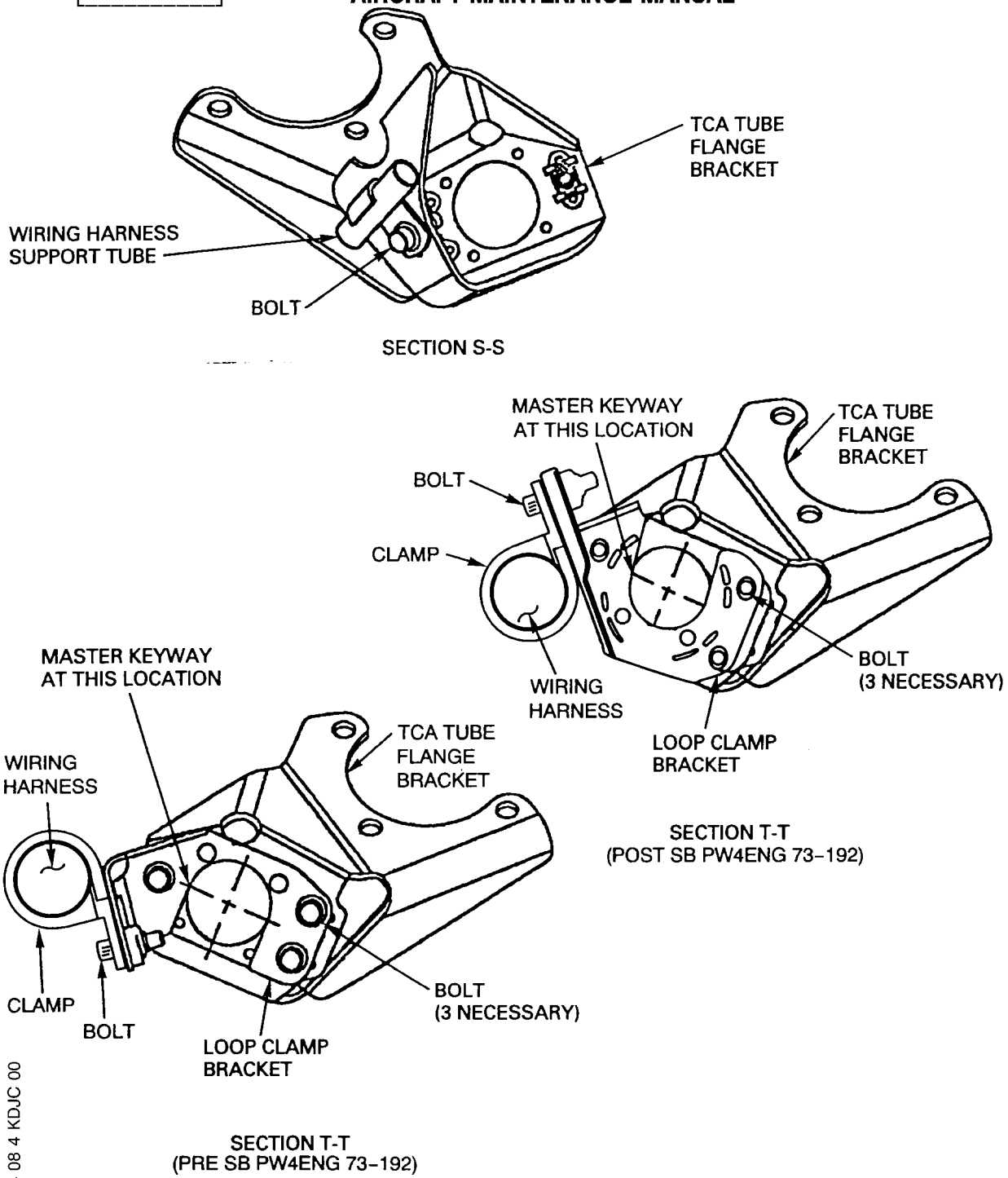


BM5 73 24 08 4 KDJB 00

L-B2663 (0000)
PW V

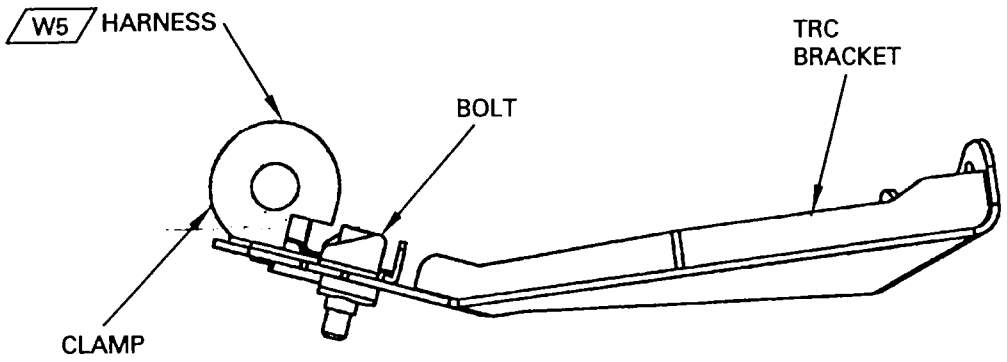
FADEC Core Engine W5 Wiring Harness Sheet 2/5
(Post SB PW4ENG 73-163)
Figure 449

R



FADEC Core Engine W5 Wiring Harness Sheet 3/5
(Post SB PW4ENG 73-163)
Figure 449

R



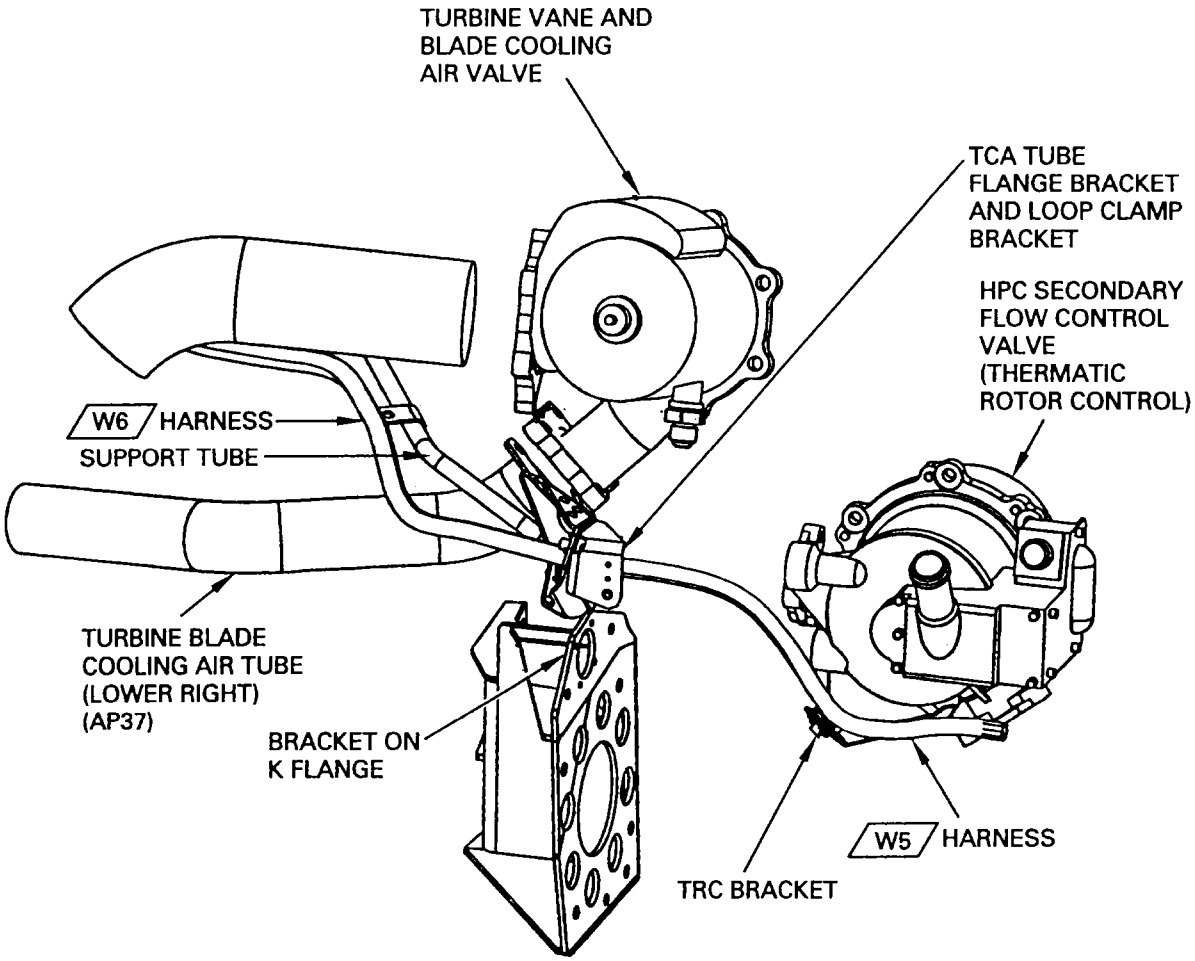
SECTION U-U

L-B2665 (0000)

BM5 73 24 08 4 KDJD 00

FADEC Core Engine W5 Wiring Harness Sheet 4/5
(Post SB PW4ENG 73-163)
Figure 449

R



L-B2666 (0000)

BM5 73 24 08 4 KDJE 00

FADEC Core Engine W5 Wiring Harness Sheet 5/5
(Post SB PW4ENG 73-163)
Figure 449

R

NOTE : This procedure gives instructions for the complete removal of both the W1 and W2 harnesses. If only the fan case is to be removed, do not remove the harnesses rearward of Flange C.

A. Job Set-Up
(1)Remove the electronic engine control (Ref. 73-21-01, P. Block 401).
(2)If the fan exit fairing (bifurcation) does not have (access) covers for harness access, remove the fairing (Ref. 72-23-06, P. Block 401).
(3)Remove the fan exit liner segments (inner rear) that are at 11 and 1 o'clock (Ref. 72-23-05, P. Block 401).

B. Equipment and Materials

ITEM	DESIGNATION
(1)PWA 85749	Torque Adapter, Electronic Harness Connectors
(2)	No.10 Torq-set Drive
Referenced Procedures	
- 72-23-05, P. Block 401	Fan Exit Liner Segments
- 72-23-06, P. Block 401	Fan Exit (Bifurcation) Fairing
- 73-21-01, P. Block 401	Full Authority Digital Engine

C. Procedure (Ref. Fig. 450, 451, 452)
(Ref. Fig. 453, 454, 455)
(Ref. Fig. 456, 457, 458)
(Ref. Fig. 459)

CAUTION : DO NOT TWIST OR BEND THE HARNESSES BADLY DURING REMOVAL OR DAMAGE TO HARNESSES CAN RESULT.

(1)For engines with the fairing (access) covers, do as follows. Use a No.10 Torq-set drive to remove the screws (Ref. Fig. 450).
(a)Cut and remove the sealant from around the (rear) cover plate. Remove the screws and cover plate.
(b)Cut and remove the sealant from around the two (access) covers. Remove the screws and the two (access) covers.
(2)For engines incorporating propulsion multiplexer unit (PMUX), disconnect W2P20 harness connector from multiplexer unit. Install protective closure on harness and unit connectors.
(3)Remove bolts, nuts and clamps securing W1 and W2 harnesses to brackets on Flanges A1, B1, B2 and C on fan case.
(4)If the intermediate case is to be removed, continue to remove the harnesses from the strut and the HPC as follows.
CAUTION : DO NOT DAMAGE THE HARNESSES WHEN YOU REMOVE THE SEALANT.
(5)Cut and remove the sealant around the grommets. Remove the sealant from around the harnesses.
(6)Remove the screws and the bolt that attach the harnesses to the intermediate case strut. Remove the clamp segment brackets, clamp segments and grommets (upper and lower) that attach the harnesses (Ref. Fig. 457).
(7)Disconnect the W1P10 and W1P11 harness connectors from the solenoid valve located in the intermediate case at approximately 1 o'clock position. Use a PWA 85749 Torque Adapter if necessary. Install protective closures on

the harness connectors and receptacles (Ref. Fig. 458, 459).
(8)Disconnect the W1P24, W1P9, W1P25 and W2P26 harness connectors from the receptacles attached to the HPC case brackets. Install protective closures on the harness connectors and receptacles.
(9)Remove two bolts and the retaining bracket that attach the W2J9 harness receptacle to the HPC bracket. Install protective closures on the harness connector and receptacle.
(10)Remove the bolts, nuts and clamps that attach the W1 and W2 harnesses to the brackets and tubes.
(11)Remove the harness ties as necessary. Remove the harnesses from the engine.

2. Remove EEC Fan Case Wiring Harnesses W1, W2, W11, W12 For Engines With a Supplemental Control Unit (SCU)

NOTE : This procedure gives instructions for the complete removal of both the W1, W2, W11 (SCU only) and W12 harnesses. If only the fan case is to be removed, do not remove the harnesses rearward of Flange C.

A. Job Set-Up
(1)Remove the electronic engine control (Ref. 73-21-01, P. Block 401).
(2)Remove the fan exit liner segments (inner rear) that are at 11 and 1 o'clock (Ref. 72-23-05, P. Block 401).

B. Equipment and Materials

ITEM	DESIGNATION
(1)PWA 85749	Torque Adapter, Electronic Harness Connectors
(2)	No.10 Torq-set Drive
Referenced Procedures	
- 72-23-05, P. Block 401	Fan Exit Liner Segments
- 73-21-01, P. Block 401	Full Authority Digital Engine

C. Procedure (Ref. Fig. 450, 460, 461)
(Ref. Fig. 462, 463, 464)
(Ref. Fig. 465, 466, 467)
(Ref. Fig. 468, 469, 470)
(Ref. Fig. 471)

CAUTION : DO NOT TWIST OR BEND THE HARNESSES BADLY DURING REMOVAL OR DAMAGE TO HARNESSES CAN RESULT.

(1)Remove the fairing (access) covers as follows. Use a No.10 Torq-set drive to remove the screws (Ref. Fig. 450).
(a)Cut and remove the sealant from around the rear cover plate. Remove the screws and cover plate.
(b)Cut and remove the sealant from around the two (access) covers. Remove the screws and the two (access) covers.
(2)For engines incorporating the supplemental control unit (SCU), disconnect W11P33 and W11P34 harness connectors from the supplemental control unit (SCU).
(3)Remove bolts, nuts and clamps securing W1, W2, W11 (SCU only) and W12

harnesses to brackets on Flanges A1, B1, B2 and C on fan case.

(4)If the intermediate case is to be removed, continue to remove the harnesses from the strut and the HPC as follows.

CAUTION : DO NOT DAMAGE THE HARNESSES WHEN YOU REMOVE THE SEALANT.

(5)Cut and remove the sealant around the grommets. Remove the sealant from around the harnesses.

(6)Remove the screws and the bolt that attach the harnesses to the intermediate case strut. Remove the clamp segment brackets, clamp segments and grommets (upper and lower) that attach the harnesses (Ref. Fig. 467).

(7)Disconnect the W1P10 and W1P11 harness connectors from the solenoid valve located in the intermediate case at approximately 1 o'clock position. Use a PWA 85749 Torque Adapter if necessary. Install protective closures on the harness connectors and receptacles (Ref. Fig. 468).

(8)Disconnect the W1P24, W1P9, W1P25 and W2P26 harness connectors from the receptacles attached to the HPC case brackets. Install protective closures on the harness connectors and receptacles.

(9)Remove two bolts and the retaining bracket that attach the W2J9 harness receptacle to the HPC bracket. Install protective closures on the harness connector and receptacle.

(10)Remove the bolts, nuts and clamps that attach the W1, W2, W11 (with SCU) and W12 harnesses to the brackets and tubes.

(11)Remove the bolts that attach the harnesses clamp segments at the 10 o'clock position on the fan case. Remove the clamp segments. Remove the harnesses from the engine.

3. Install EEC Fan Case Wiring Harnesses W1 and W2 For Engines Without a Supplemental Control Unit (SCU)

NOTE : This procedure provides for installation of the EEC fan case wiring harnesses W1 and W2 when the fan case is installed to the intermediate case.

A. Job Set-Up

(1)If it is necessary to install a new access cover, (Ref. 72-23-06, P. Block 801) for instructions on the installation of boltholes in the access cover.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Glenair TG-70 Strap Wrench or Glenair TG-69 Soft Jawed Pliers
(2)	No.10 Torq-set Drive
(3)PWA 86157	Box, Simulator
(4)PWA 86158	Box, Simulator
(5)PWA 86159	Bar, Simulator
(6)PWA 86211	Panel, Simulator
(7)PWA 86212	Panel, Simulator
(8)Material No.P03-001	Oil, Engine (PWA 521B)
(9)Material No.P05-099	Tape, Moisture Resistant, Green (PMC4141)

ITEM	DESIGNATION
10)Material No.P05-124	Ties, Twist
11)Material No.P09-019	Sealant, Flame Resistant Silicone Rubber (PWA 36751-1)
12)Material No.P09-027	Sealant, Silicone Rubber (PWA 36003-2)
13)Material No.P11-009	Alcohol, Denatured Ethyl (AMS 3002)
14)Material No.P18-007	Primer, Silicone (PWA 36086-2)
Referenced Procedures	
- 72-23-05, P. Block 401	Fan Exit Liner Segments
- 72-23-06, P. Block 401	Fan Exit (Bifurcation) Fairing
- 72-23-06, P. Block 801	Fan Exit (Bifurcation) Fairing
- 73-21-01, P. Block 401	Full Authority Digital Engine

C. Procedure (Ref. Fig. 451, 452, 458)
(Ref. Fig. 459, 457, 456)
(Ref. Fig. 455, 454, 453)
(Ref. Fig. 472, 473)

CAUTION : DO NOT TWIST OR BEND THE HARNESSES BADLY DURING THE INSTALLATION OR DAMAGE TO THE HARNESSES CAN RESULT.

(1)Measure the W1 harness from the W1P25 harness connector and make a mark per dimension given in (Ref. Fig. 473) (Sheet 2).

(2)Measure the W2 harness from the W2J9 harness connector and make a mark per dimension given in (Ref. Fig. 473) (Sheet 2).

(3)Set the W1 and W2 wiring harnesses on the left side of the fan case and down through the intermediate case strut at 12 o'clock position. Keep the W1 harness to the right of the strut and the W2 harness to the left of the strut. Continue to set harnesses on to the HPC case. See (Ref. Fig. 473) for harness routing.

(4)Adjust harness positions and temporarily install Twist Ties (Material No.P05-124) to attach the harnesses to engine brackets.

(5)Install the EEC over the harnesses and attach with work bolts temporarily.

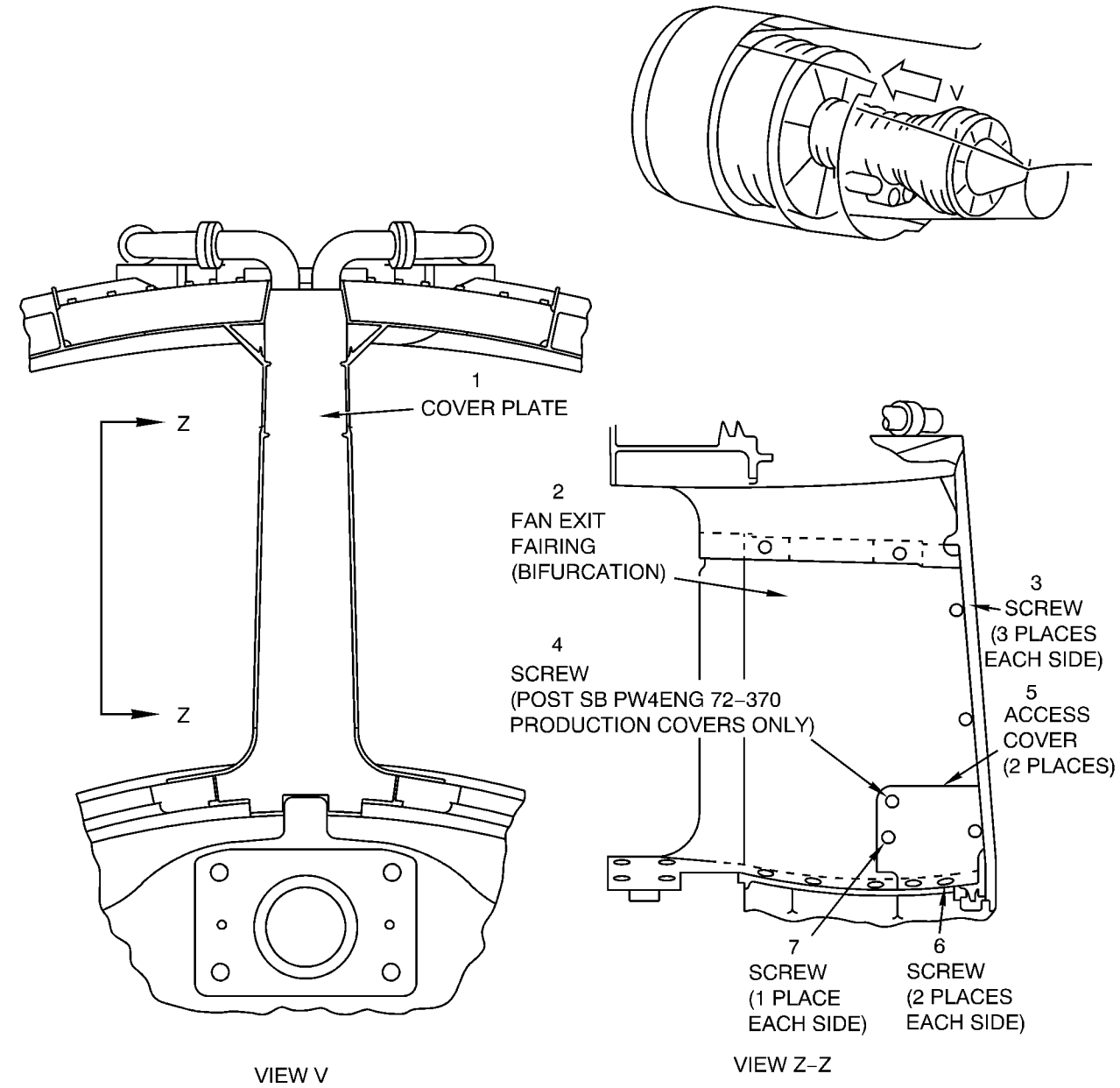
(6)Connect the W1 and W2 harness connectors (given below) to the mating harness receptacles as follows. See (Ref. Fig. 452) for connector locations. For each connector :

CAUTION : IF ENGINE HAS THE HPC RING CASE CONFIGURATION (BASIC OR POST SB PW4ENG 72-756), MAKE SURE YOU INSTALL THE CORRECT W1 AND W2 HARNESSES, PROGRAMMING PLUG AND EEC. IF YOU DO NOT INSTALL THE CORRECT HARDWARE, THE ENGINE WILL NOT OPERATE.

(a)If W1 and W2 harnesses have yellow bands, you must have an EEC with the yellow and black label (For Ring Case Configuration) (Ref. Fig. 472, 453).

(b)Remove the protection covers. Examine the harness connector and the mating receptacle for bent pins and contamination. If necessary, carefully make straight any bent pins. If necessary, clean the connector and receptacle with Denatured Ethyl Alcohol (Material No.P11-009). Let dry.

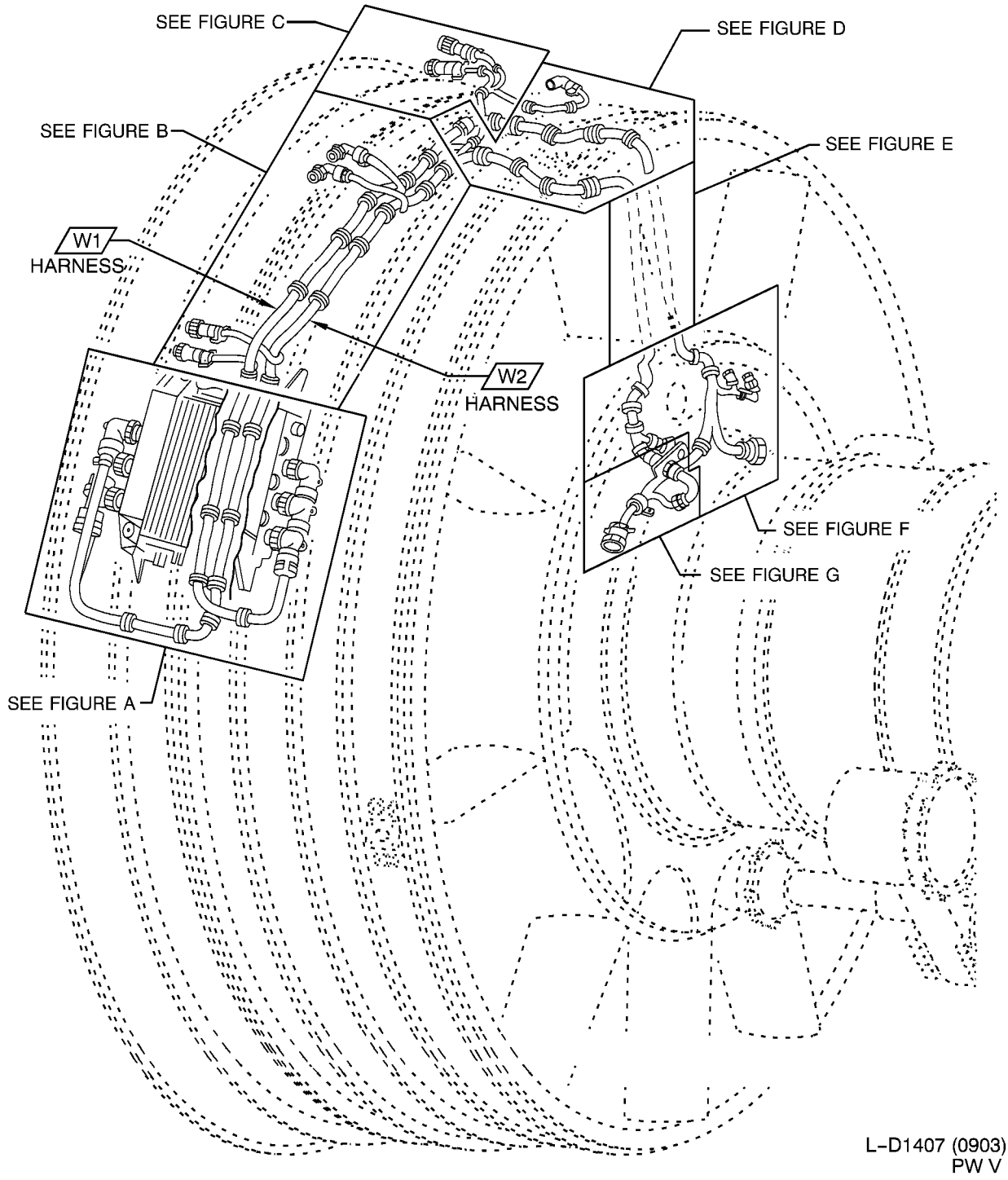
(c)Align the connector keyways and engage the connector to the mating receptacle. Tighten the connector coupling nut by hand until you cover



BM5 73 24 08 4 KQA0 00

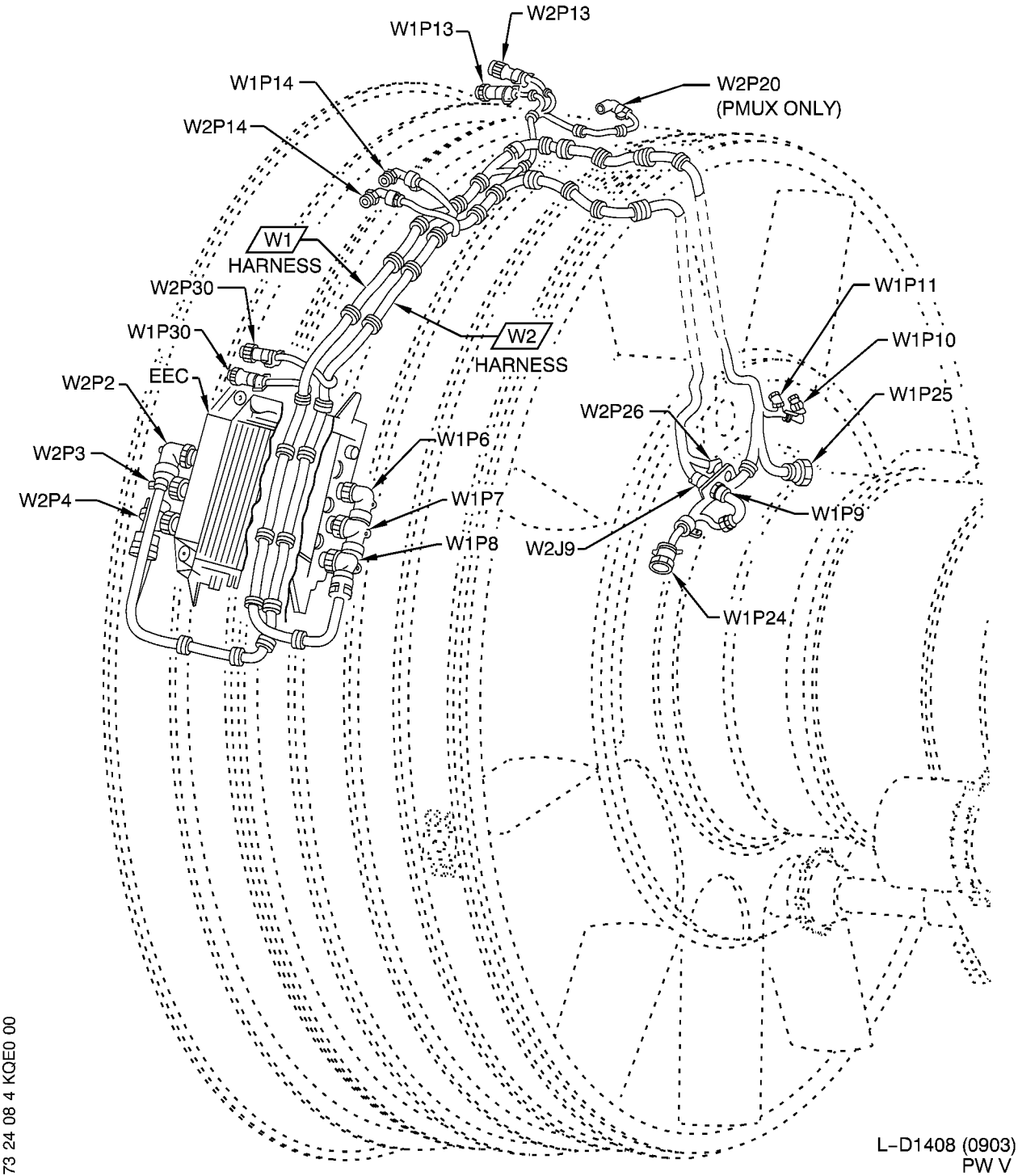
L-D1406 (0903)
PW V

Fan Exit Fairing (Bifurcation)
Figure 450



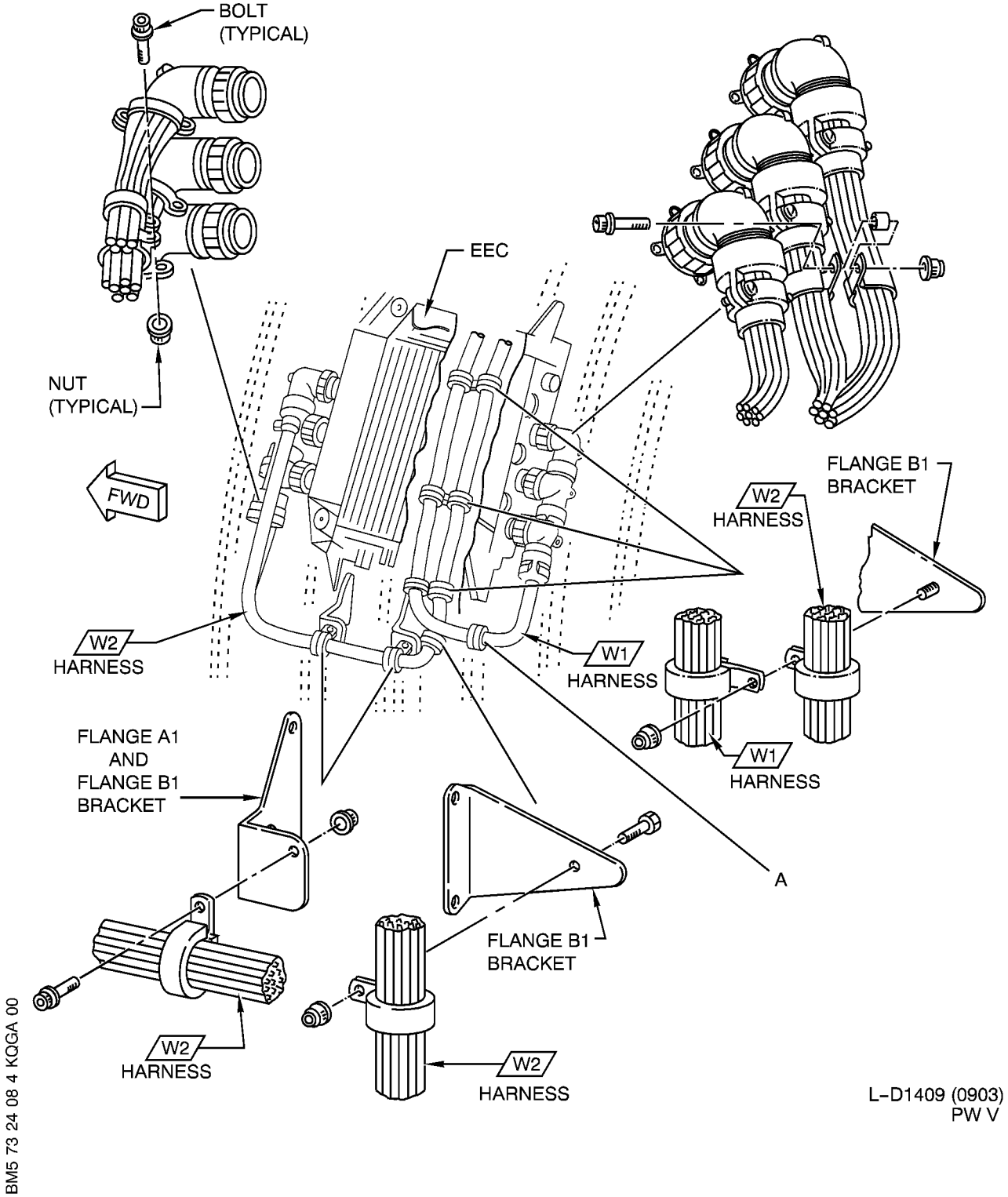
BM5 73 24 08 4 KQC0 00

EEC Fan Case Wiring Harnesses Without SCU
Figure 451

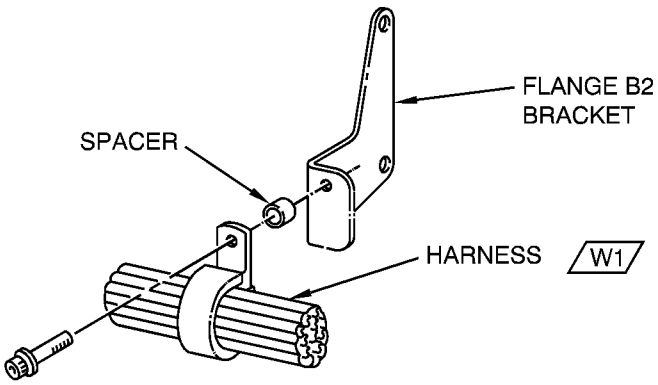


BM5 73 24 08 4 KQE0 00

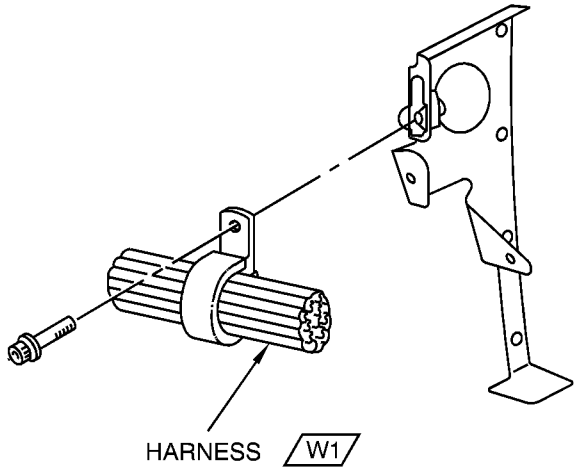
EEC Fan Case Wiring Harnesses Without SCU
Figure 452



EEC Fan Case Wiring Harnesses Without SCU - FIGURE A
(Sheet 1)
Figure 453

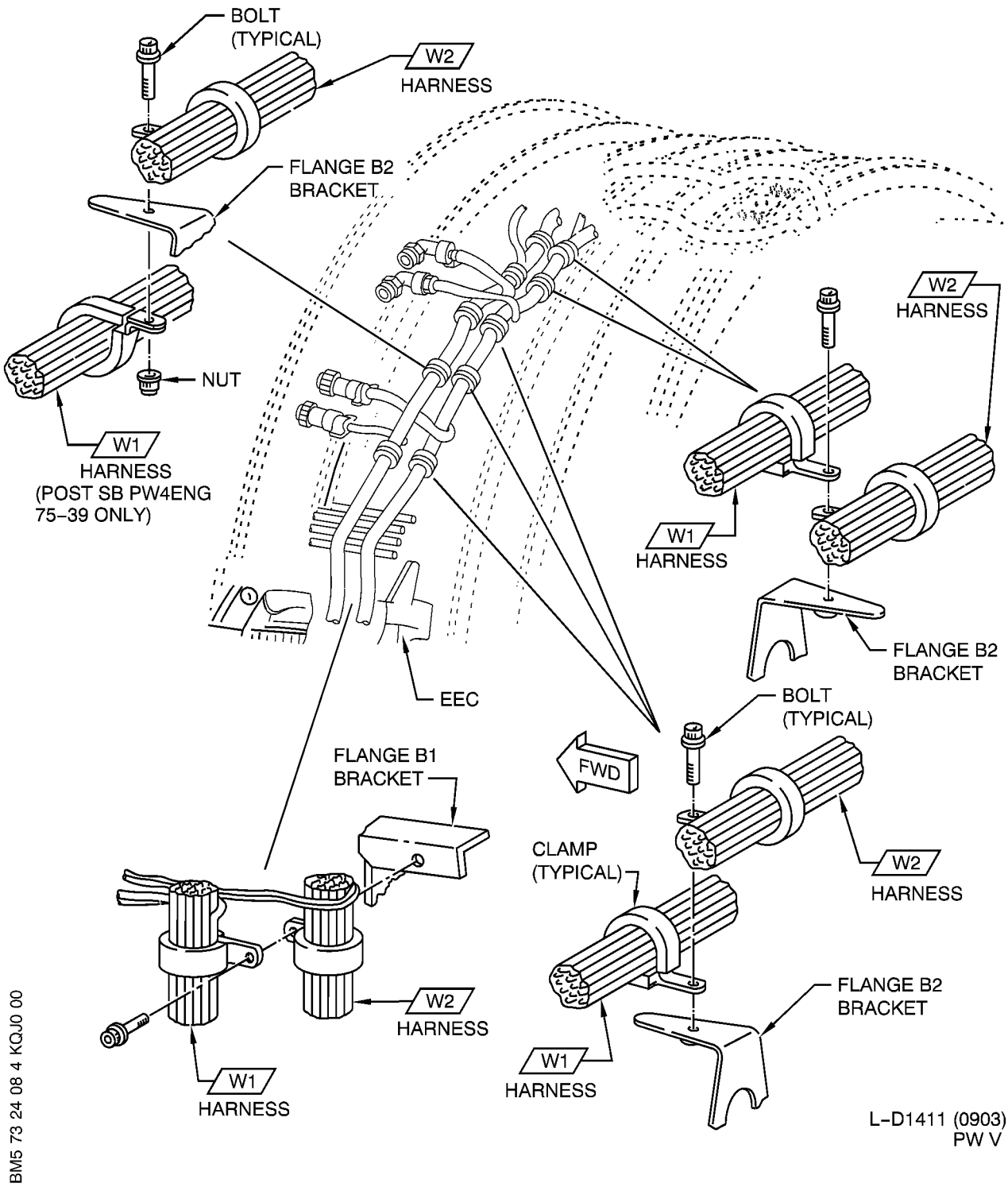


VIEW A
(PRE SB PW4ENG 73-143)

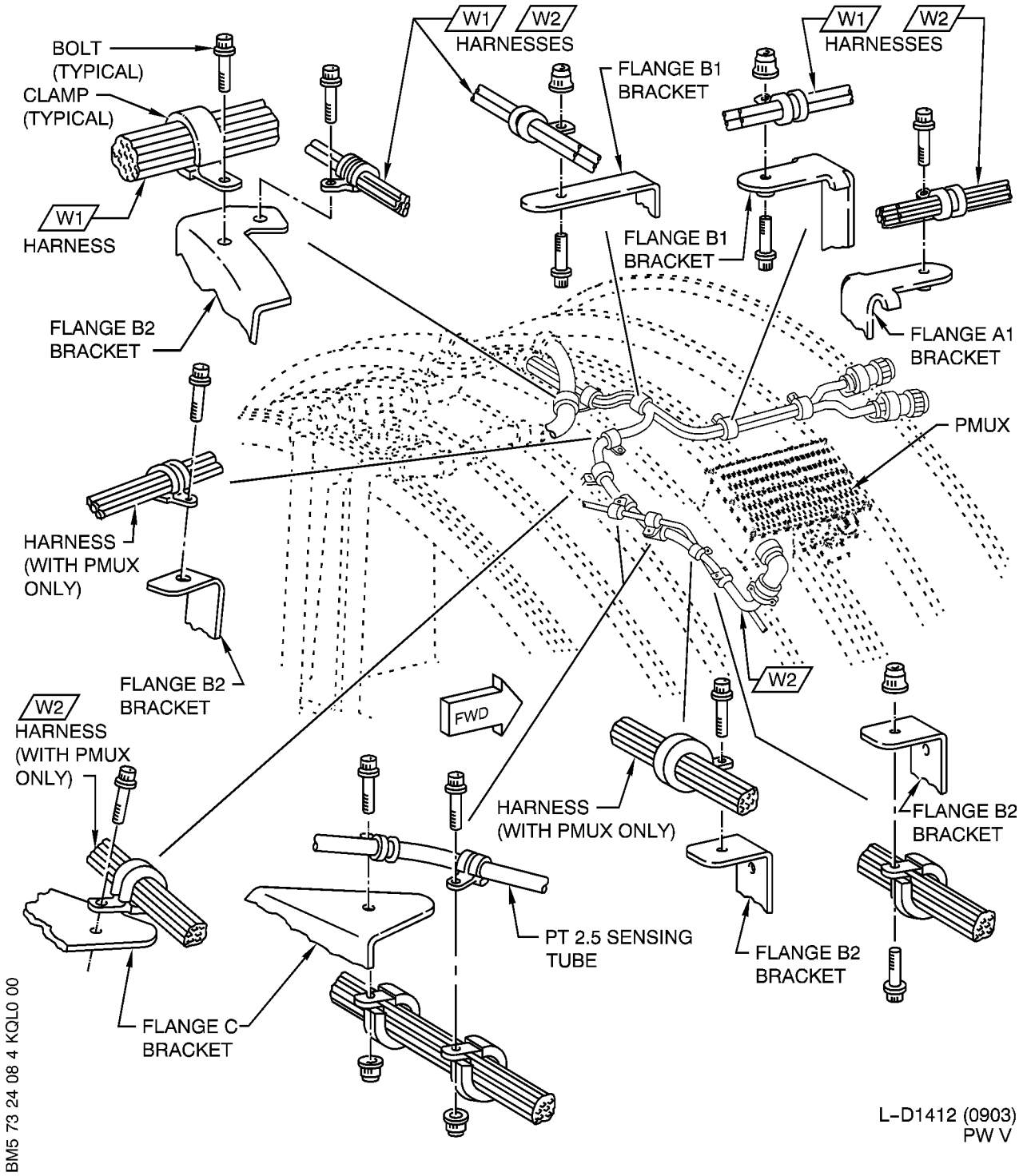


VIEW A
(POST SB PW4ENG 73-143)

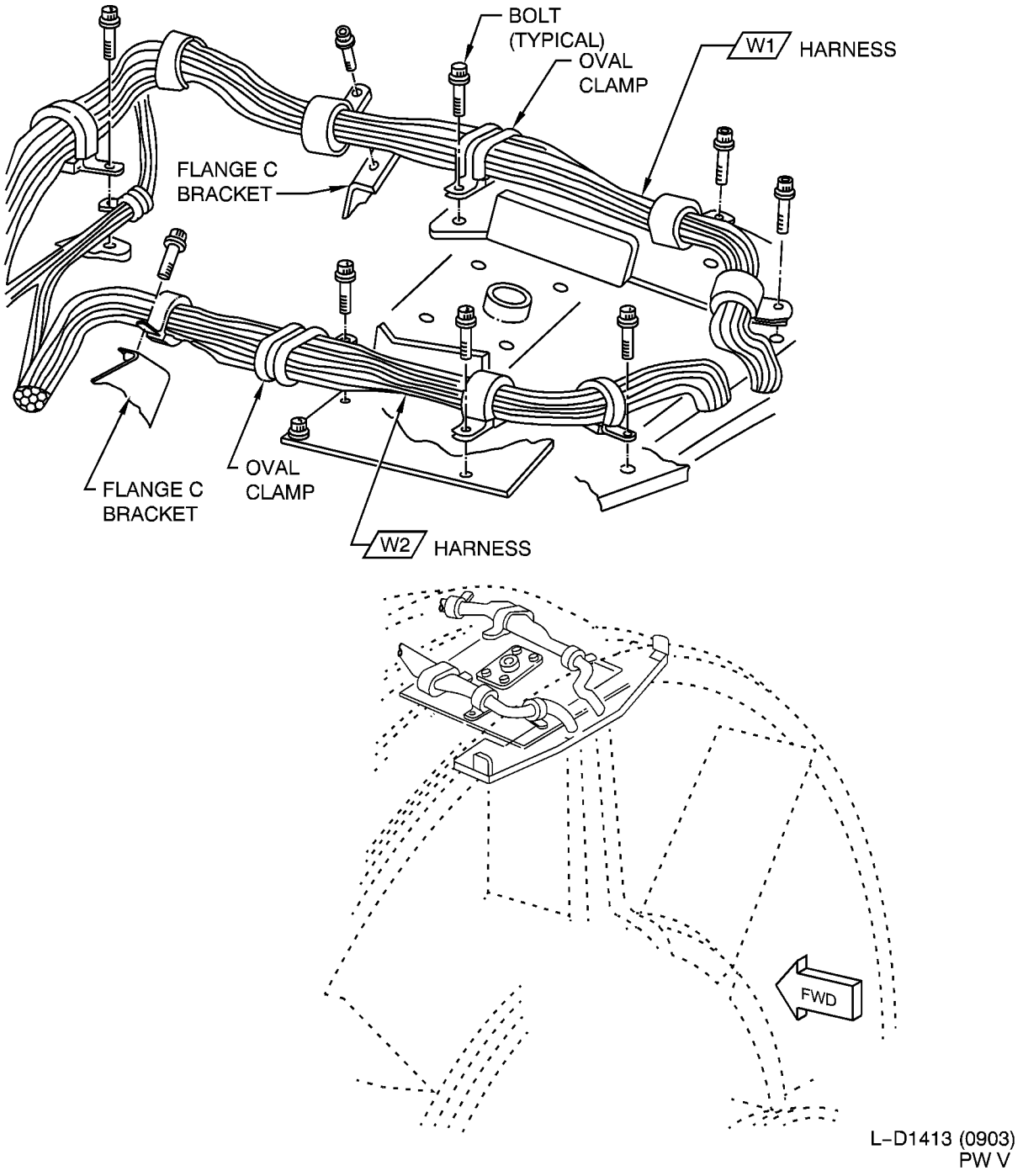
EEC Fan Case Wiring Harnesses Without SCU - FIGURE A
(Sheet 2)
Figure 453



EEC Fan Case Wiring Harnesses Without SCU - FIGURE B
Figure 454

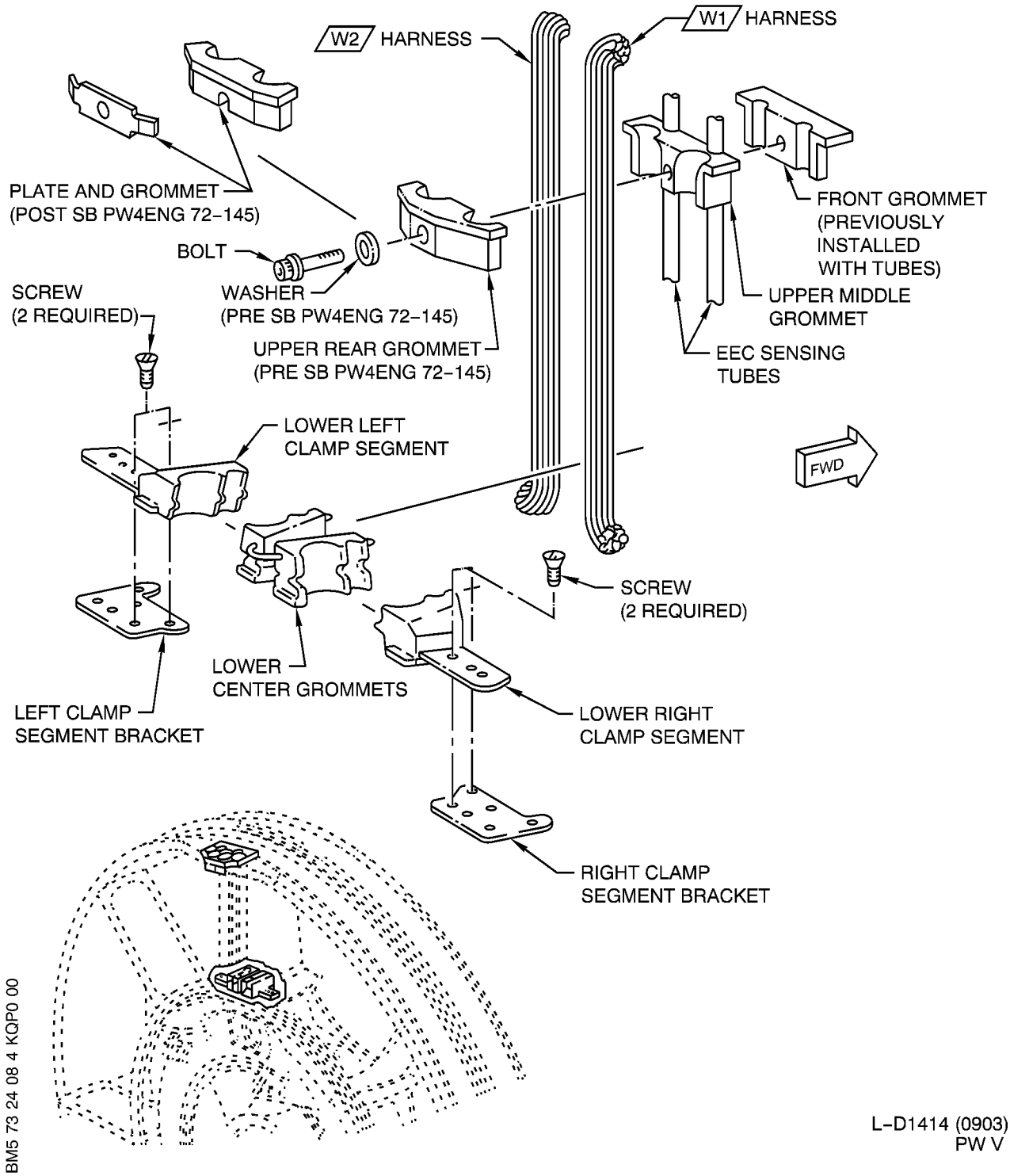


EEC Fan Case Wiring Harnesses Without SCU - FIGURE C
Figure 455

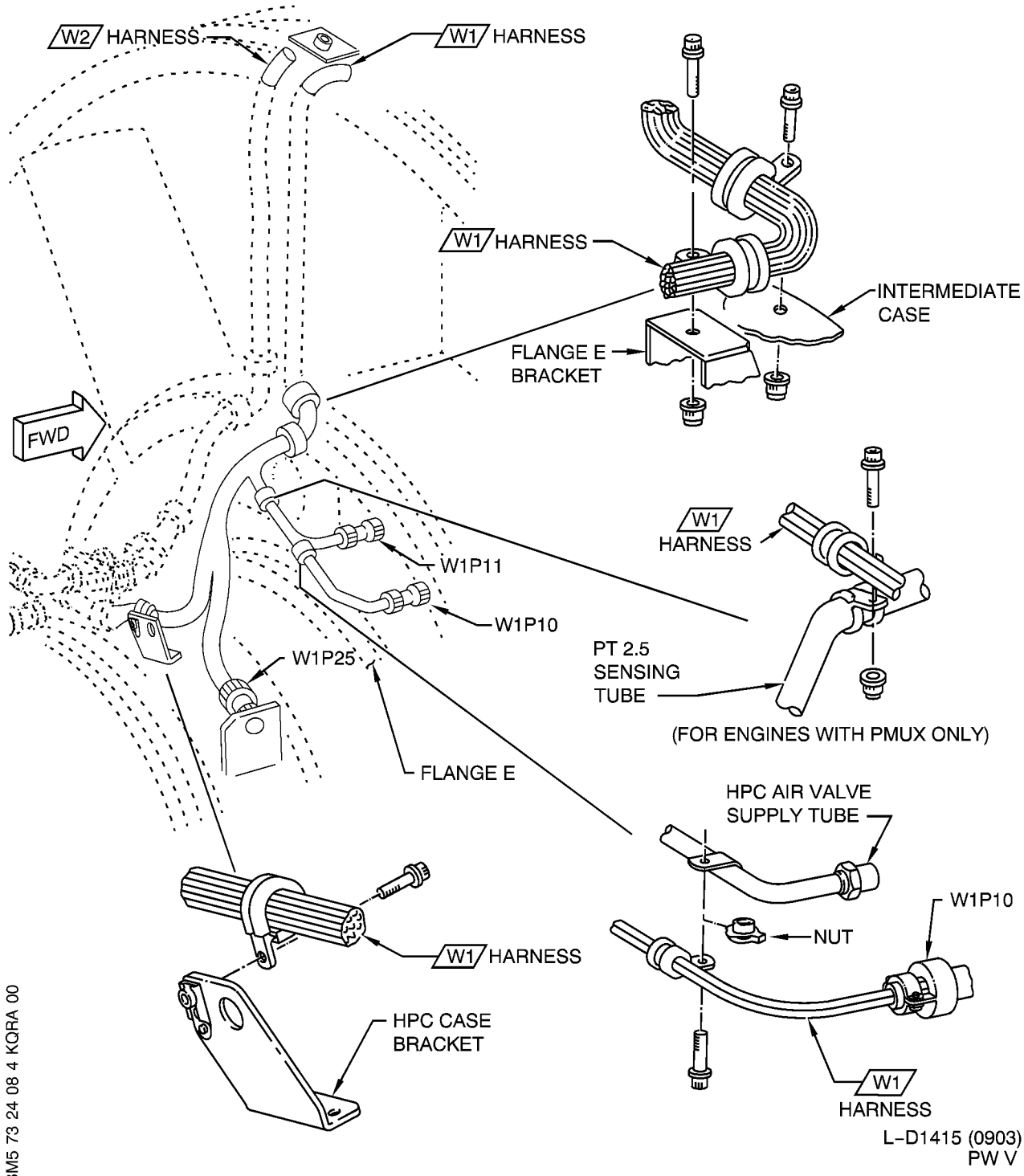


BM5 73 24 08 4 KQN0 00

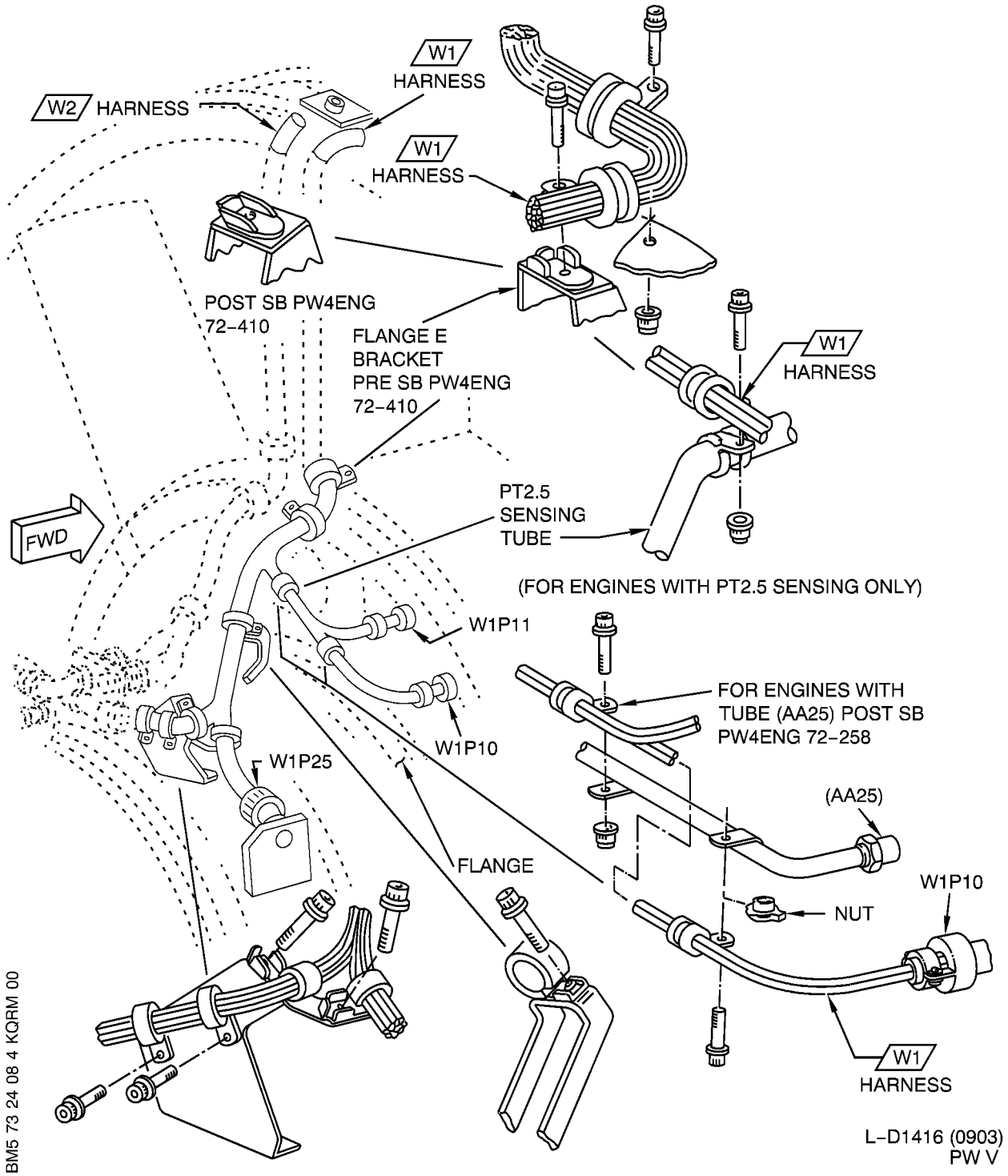
EEC Fan Case Wiring Harnesses Without SCU - FIGURE D
Figure 456



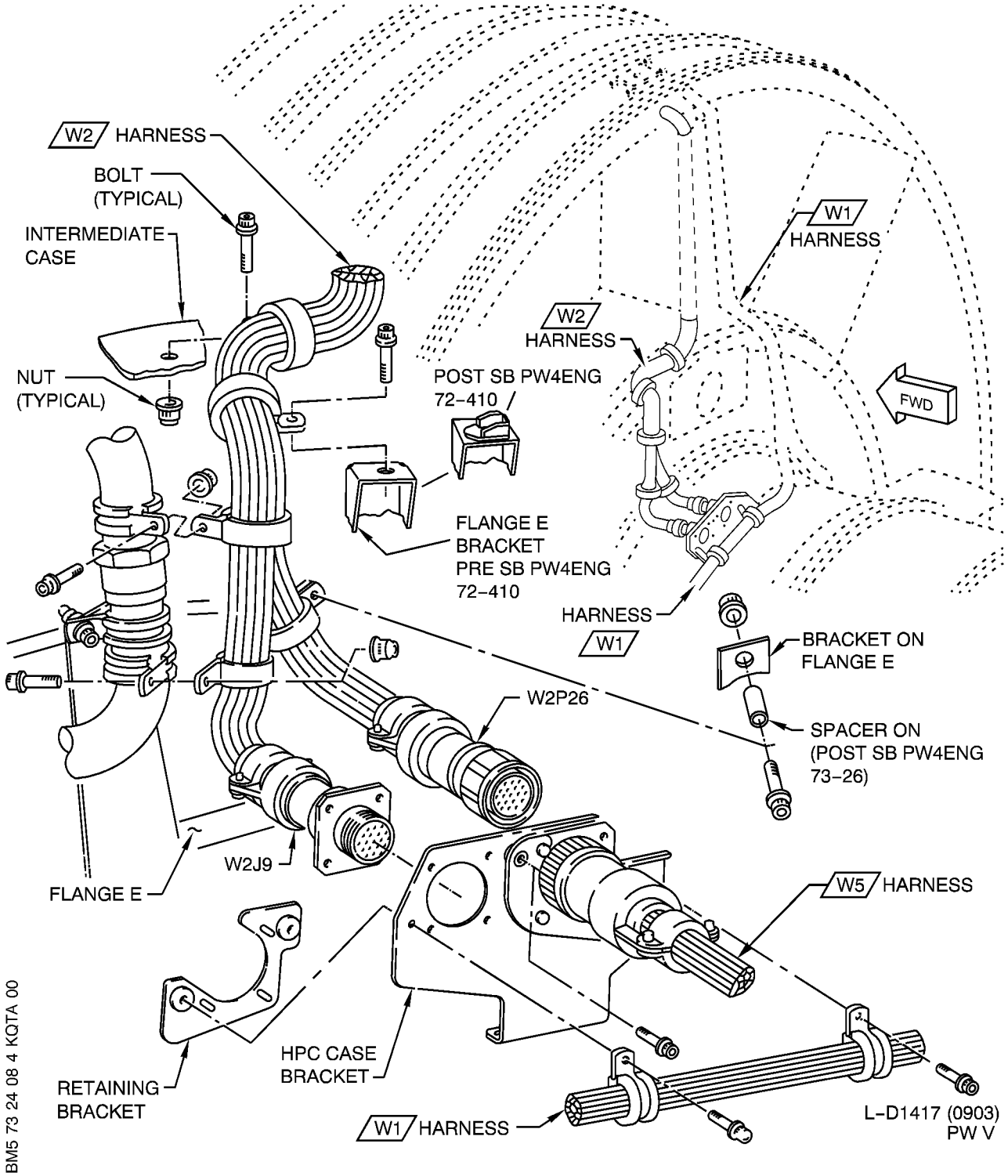
EEC Fan Case Wiring Harnesses Without SCU - FIGURE E
Figure 457



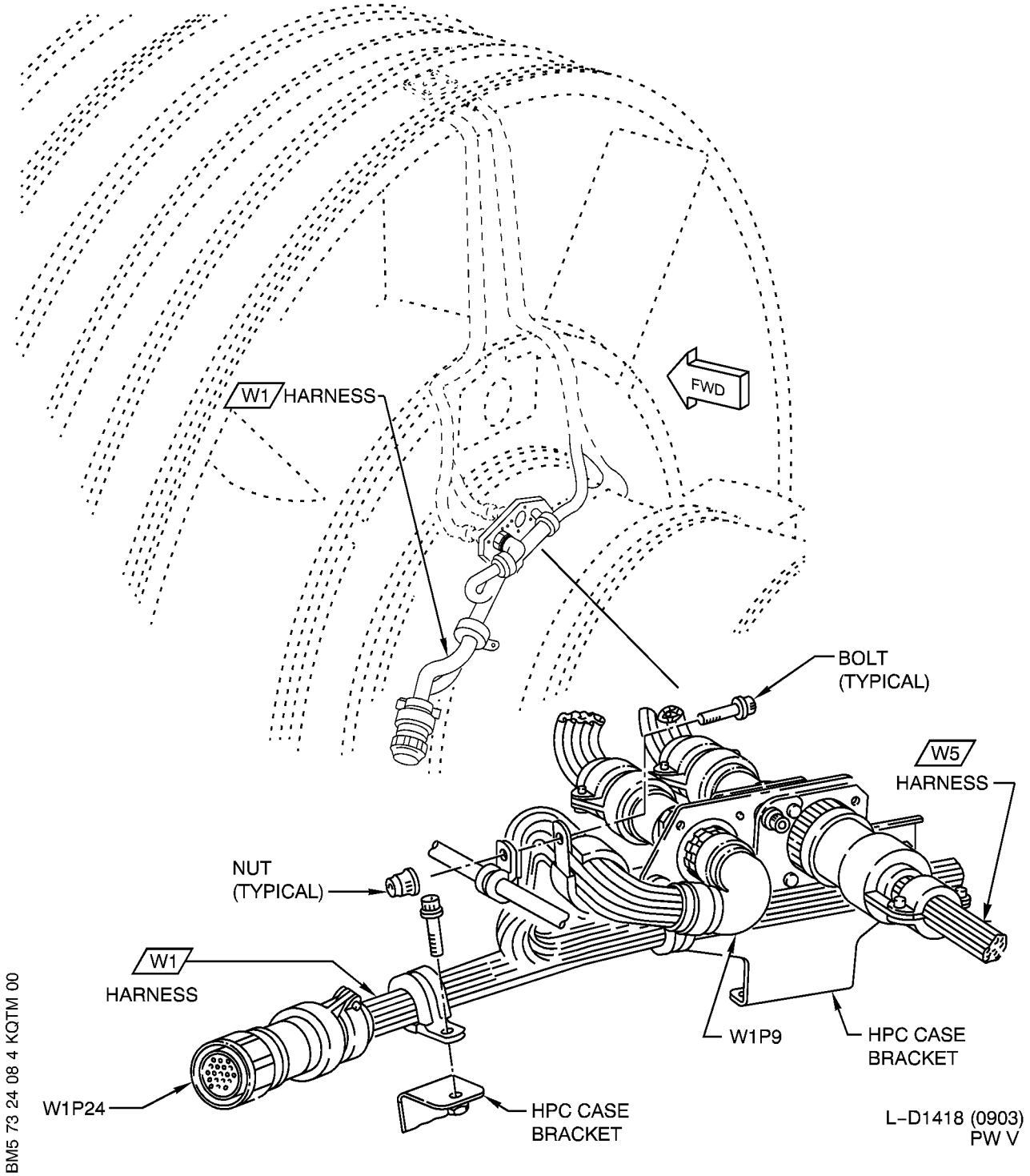
EEC Fan Case Wiring Harnesses Without SCU - FIGURE F
Pre SB PW4ENG 72-258 (Sheet 1)
Figure 458



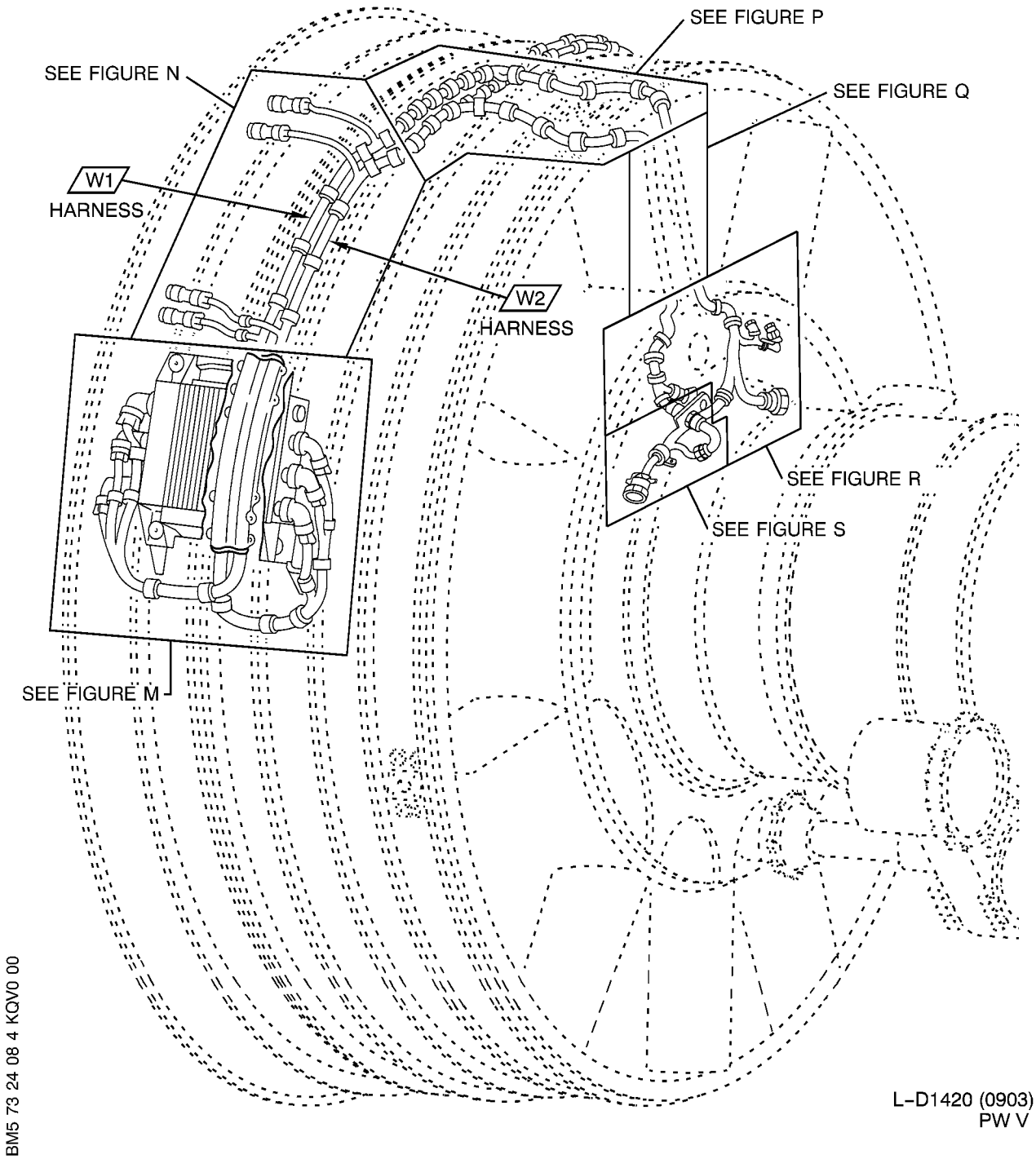
EEC Fan Case Wiring Harnesses Without SCU - FIGURE F
Post SB PW4ENG 72-258 (Sheet 2)
Figure 458



EEC Fan Case Wiring Harnesses Without SCU - FIGURE G
(Sheet 1)
Figure 459

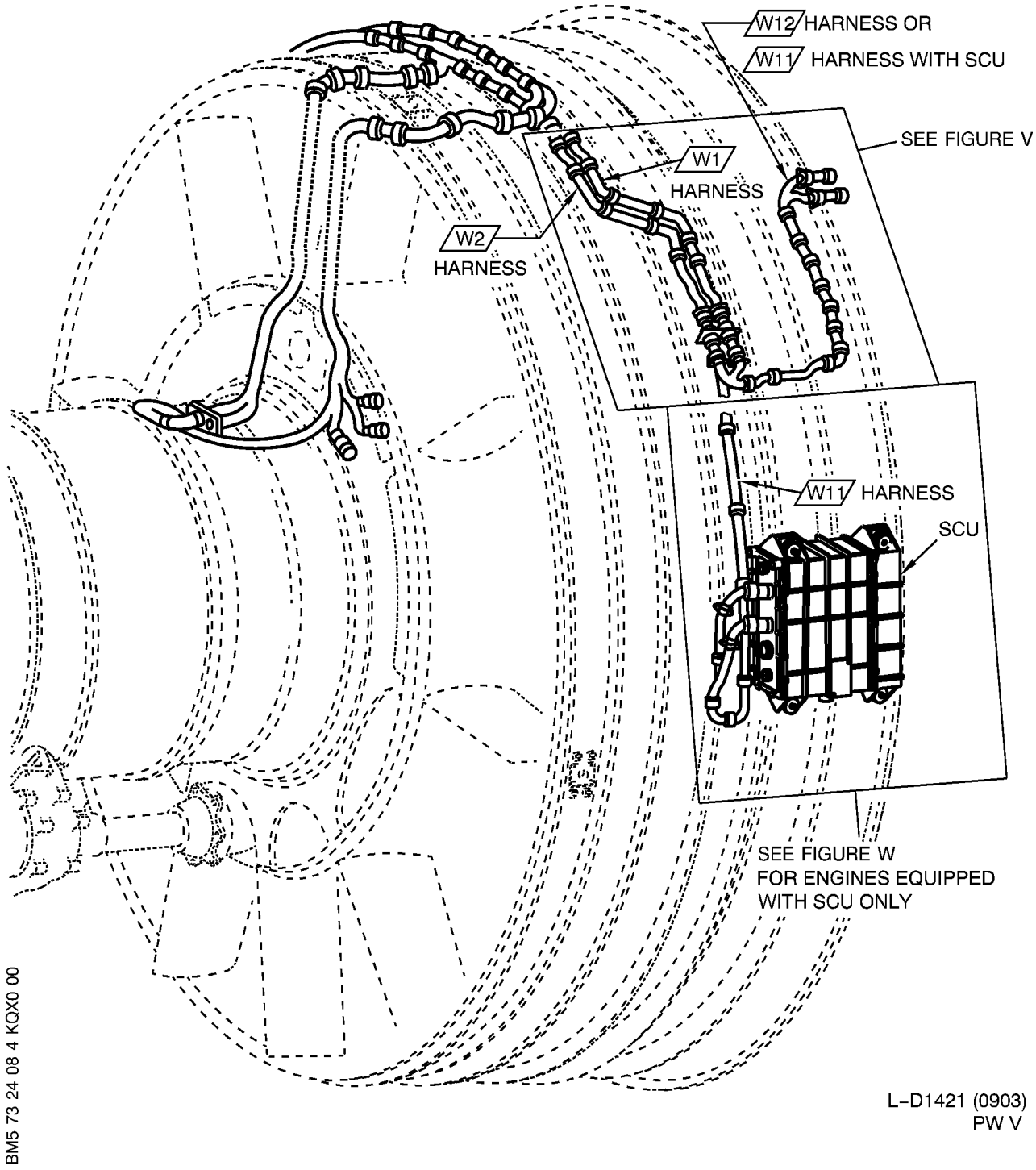


EEC Fan Case Wiring Harnesses Without SCU - FIGURE G
(Sheet 2)
Figure 459

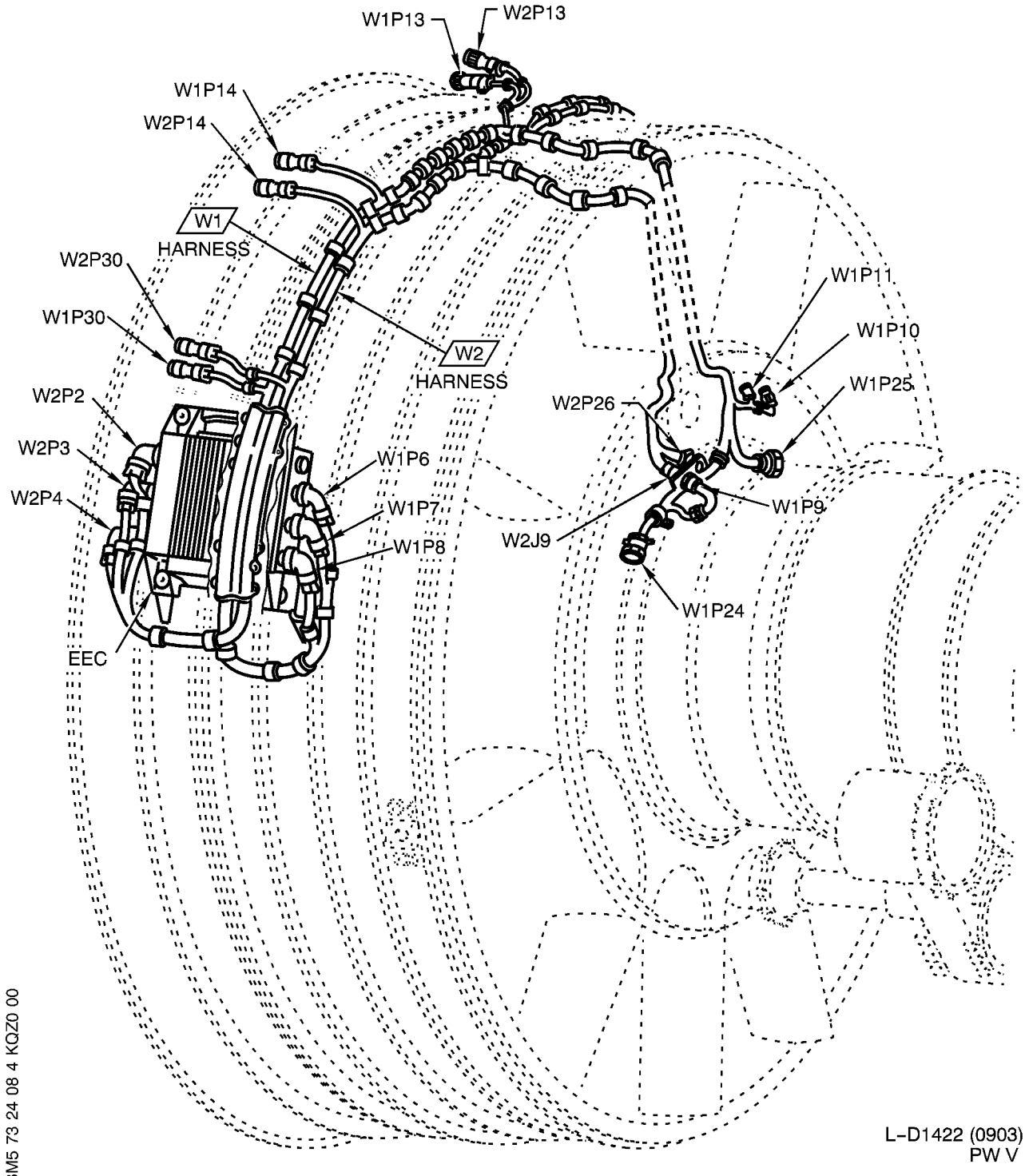


BM5 73 24 08 4 KQV0 00

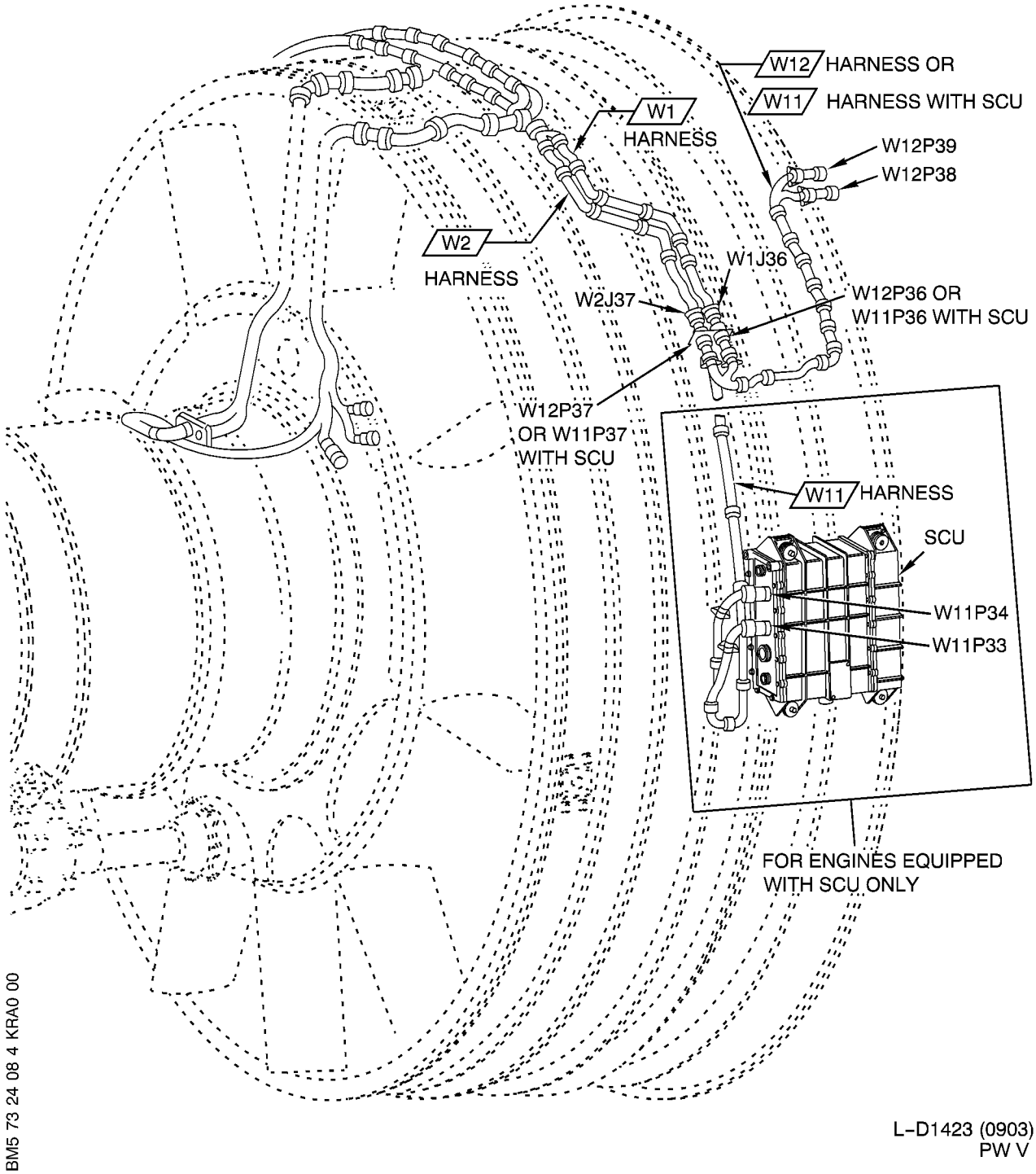
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
Figure 460



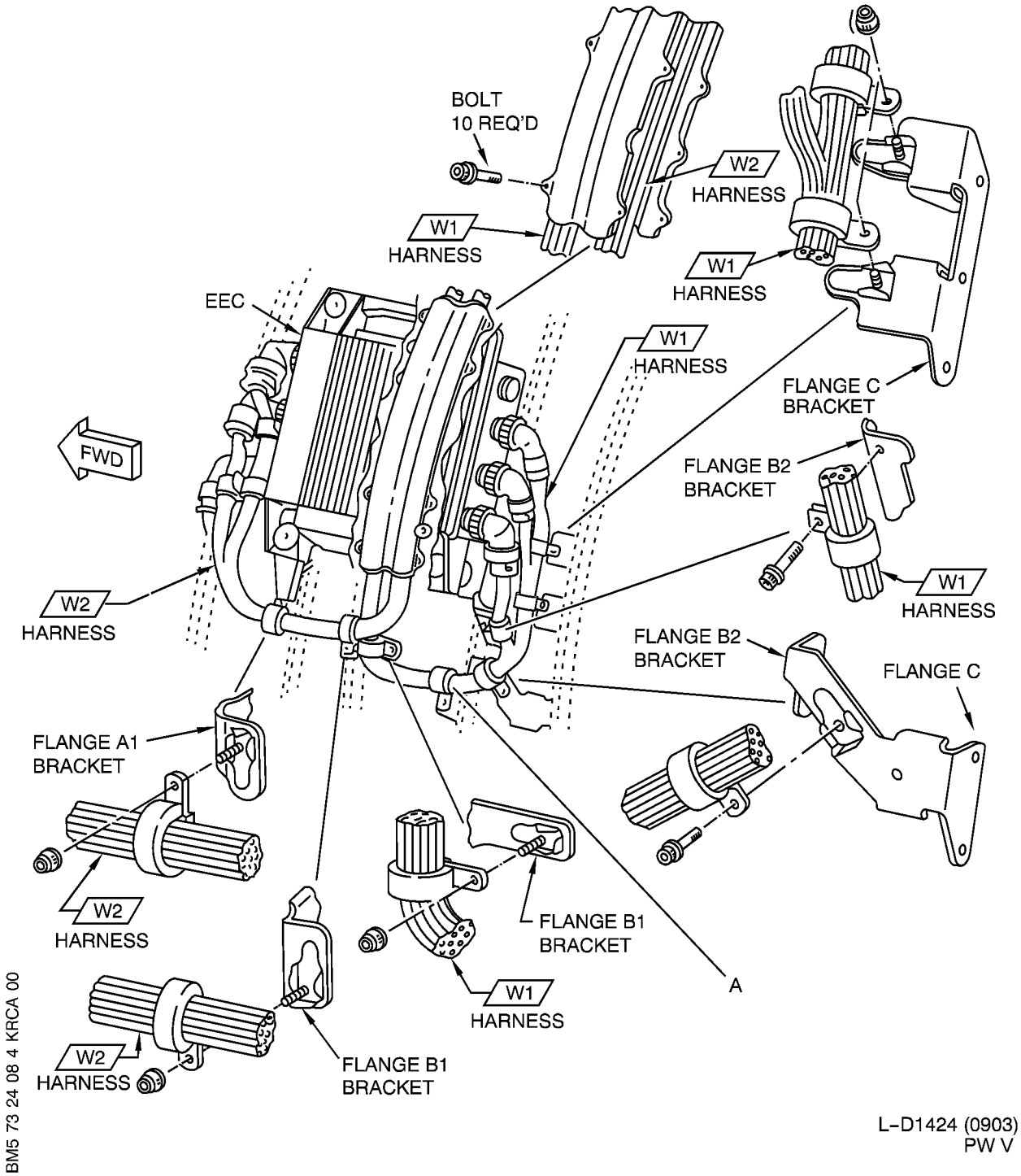
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
Figure 461



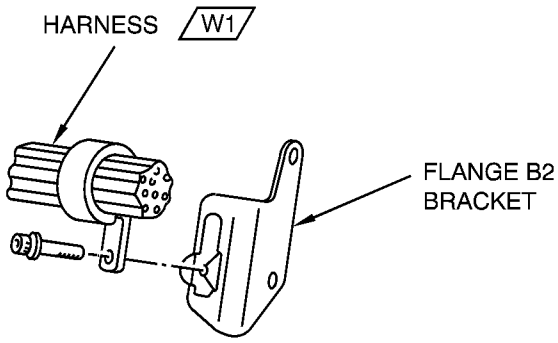
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
Figure 462



EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
Figure 463

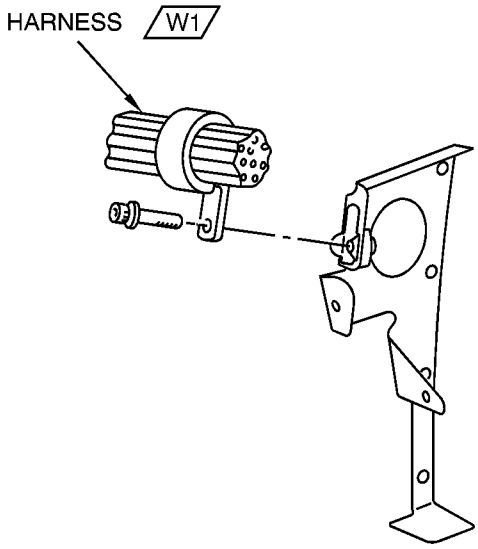


EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE M (Sheet 1)
Figure 464



VIEW A

(PRE SB PW4ENG 73-143)



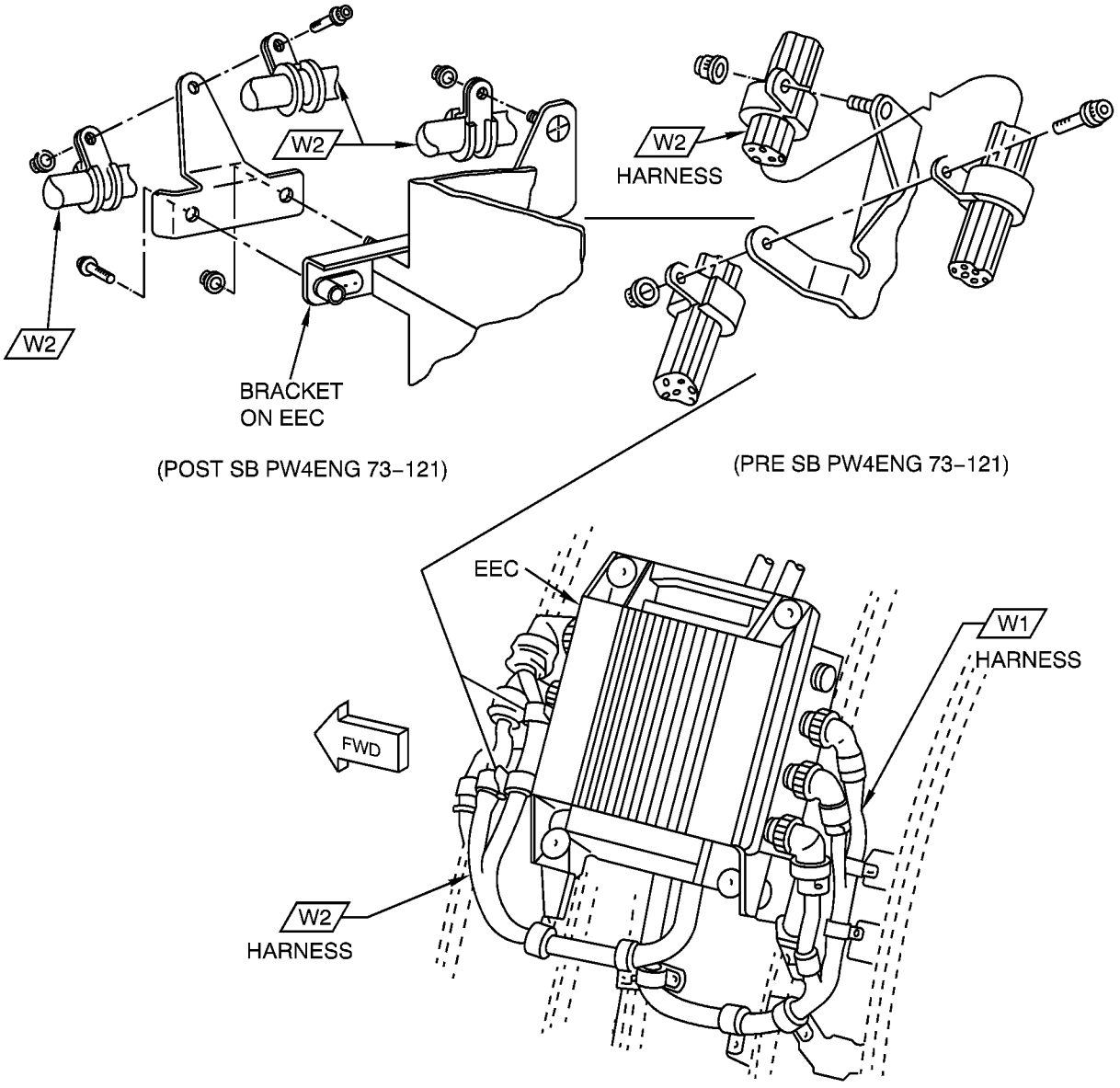
VIEW A

(POST SB PW4ENG 73-143)

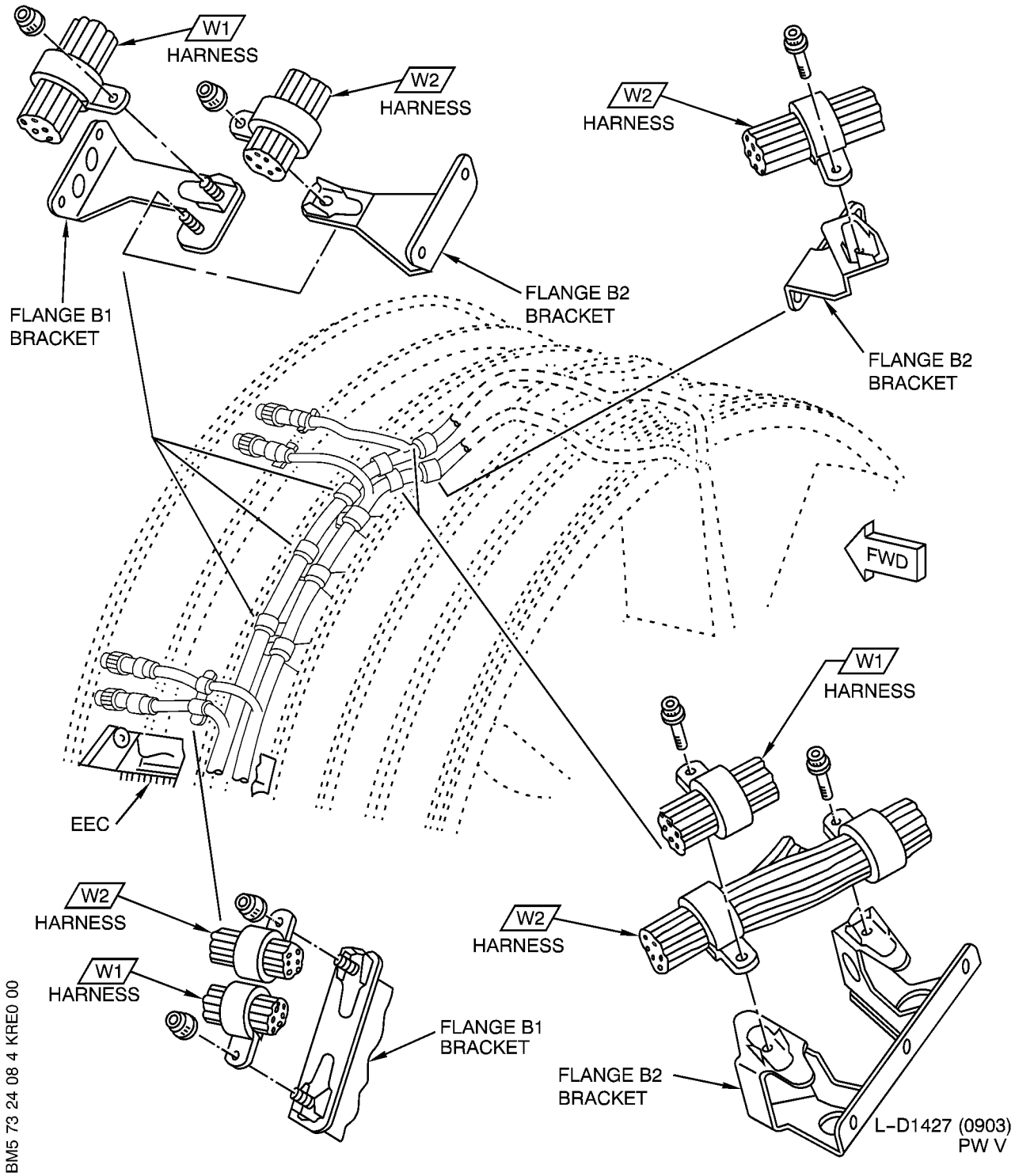
BM5 73 24 08 4 KRCJ 00

L-D1425 (0903)
PW V

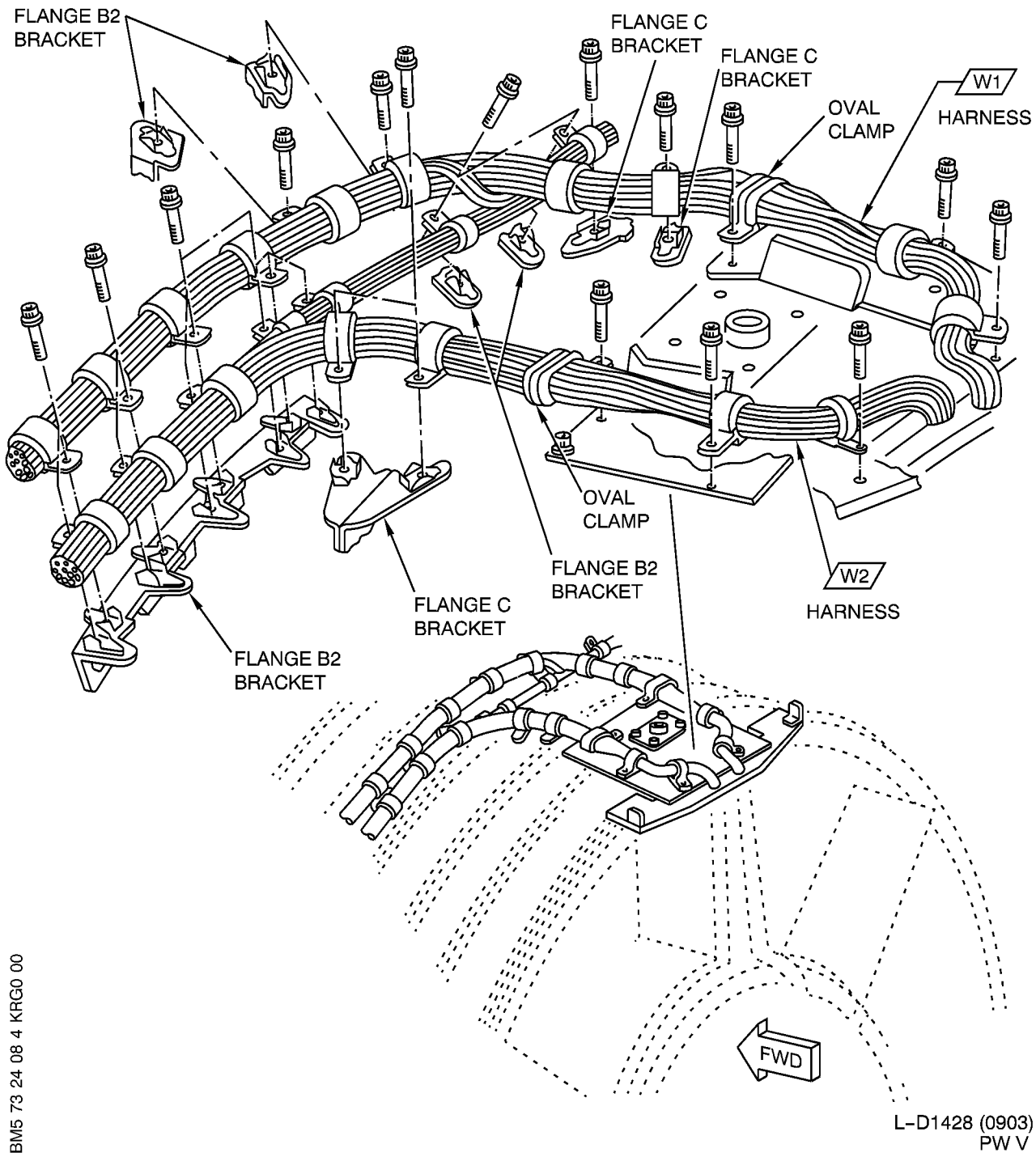
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE M (Sheet 2)
Figure 464



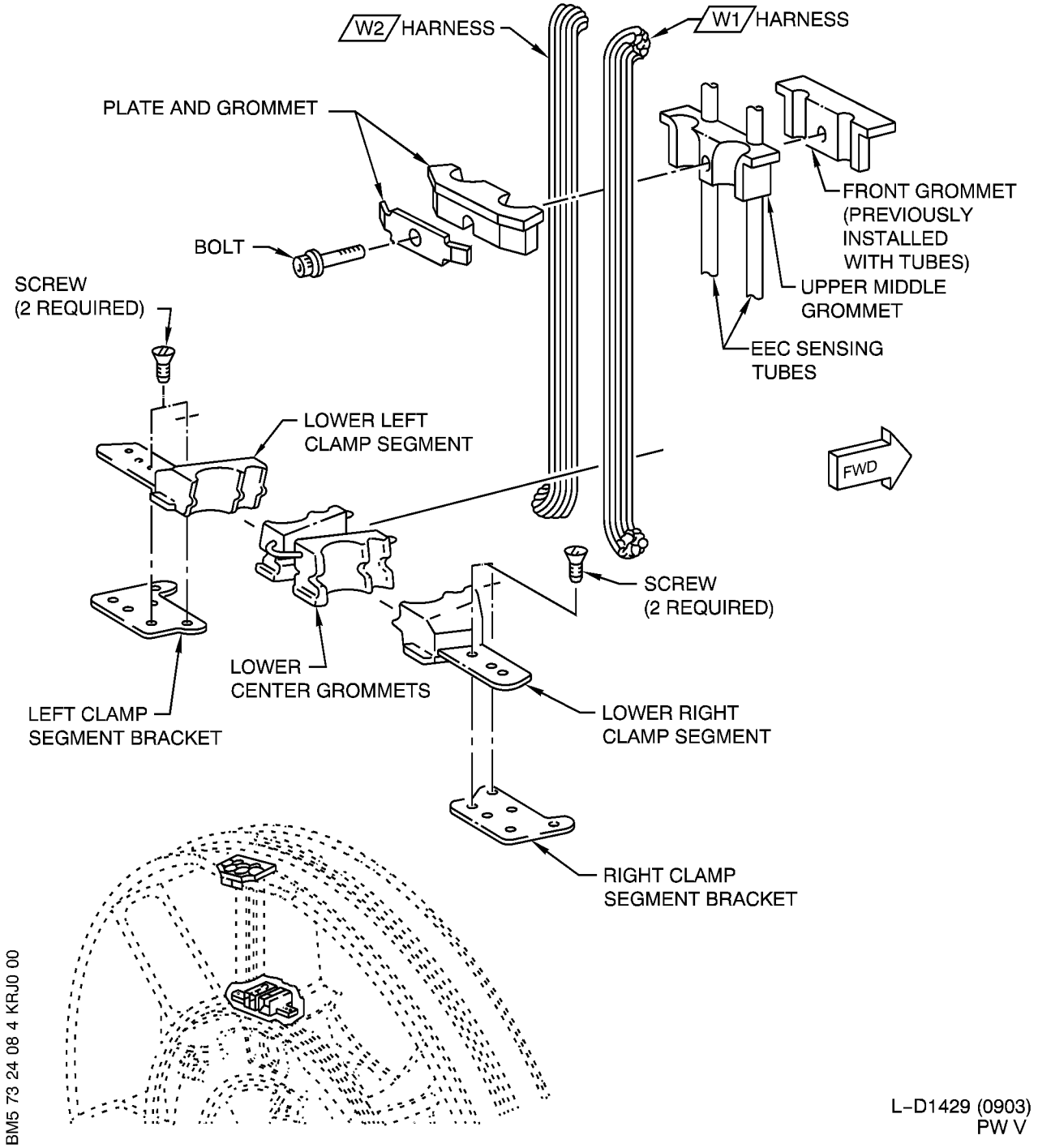
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE M (Sheet 3)
Figure 464



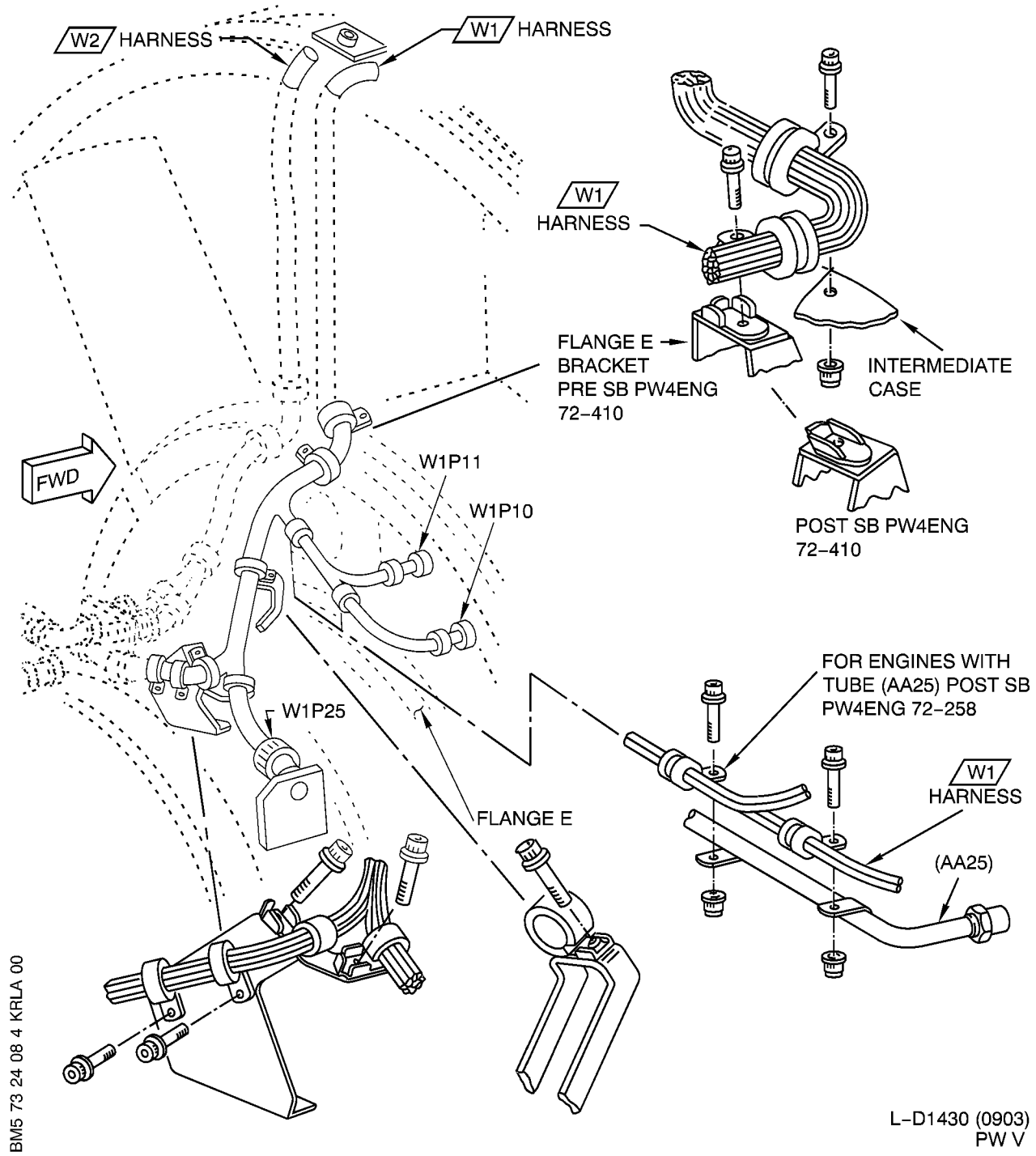
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE N
Figure 465



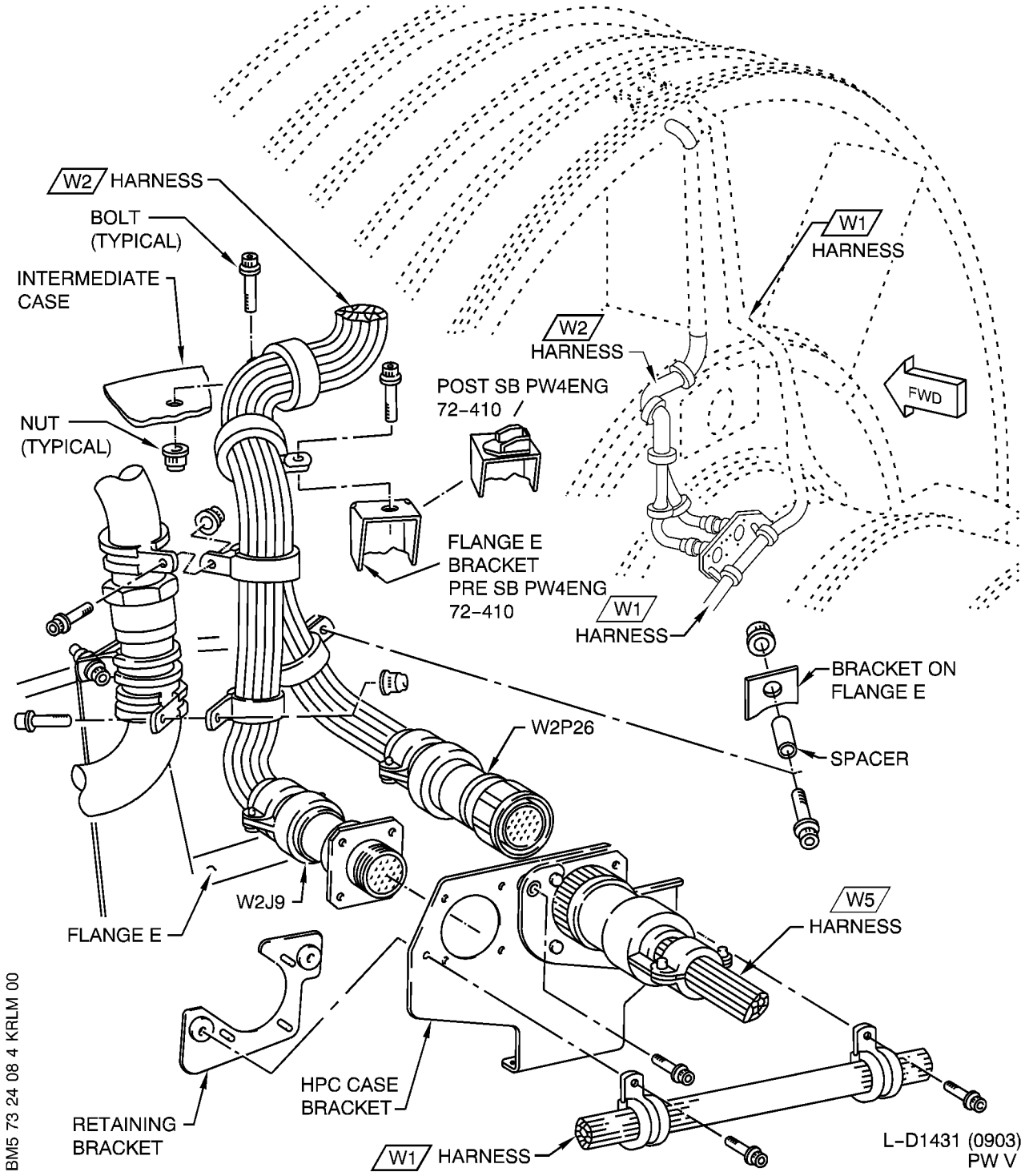
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE P
Figure 466



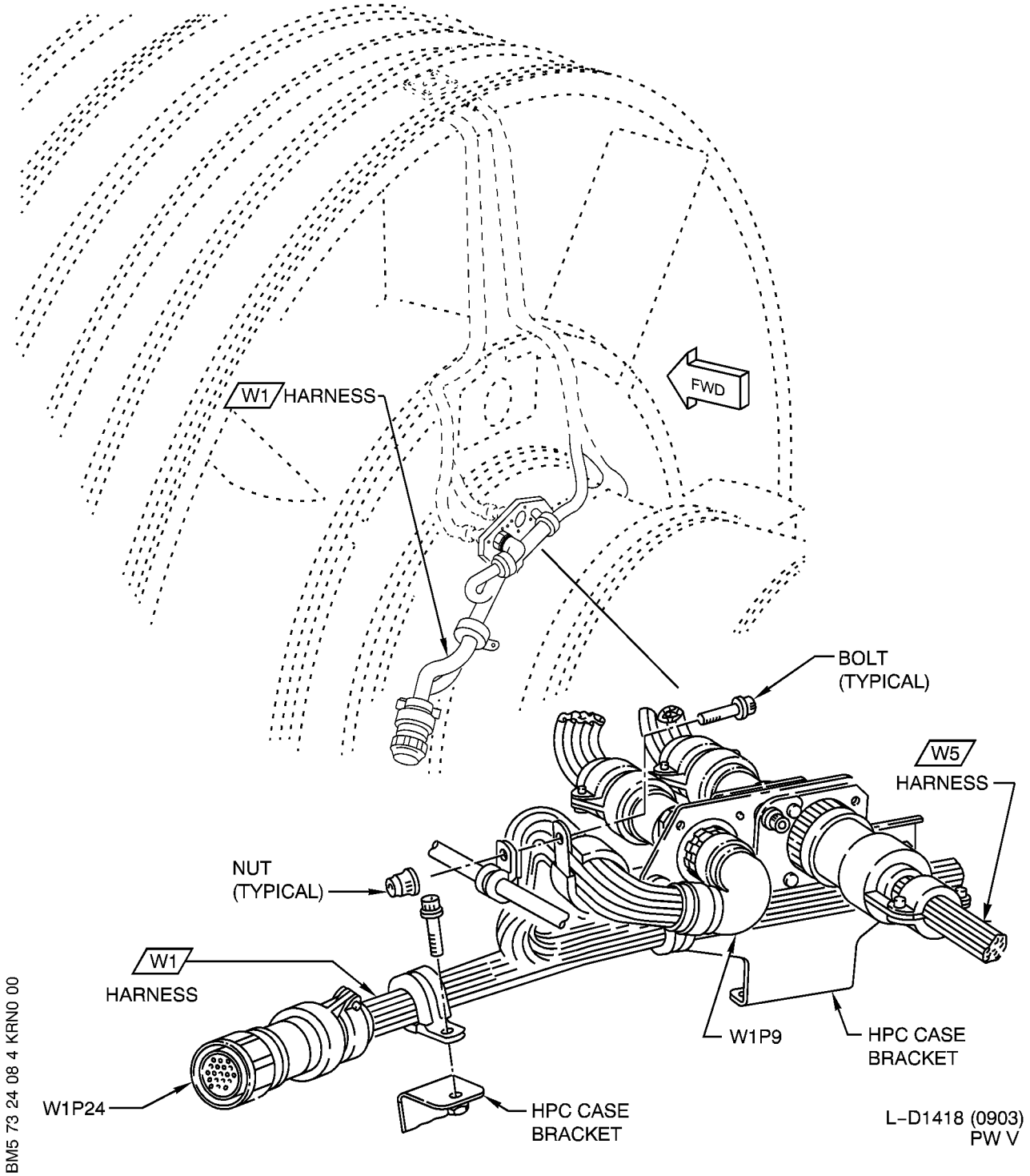
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE Q
Figure 467



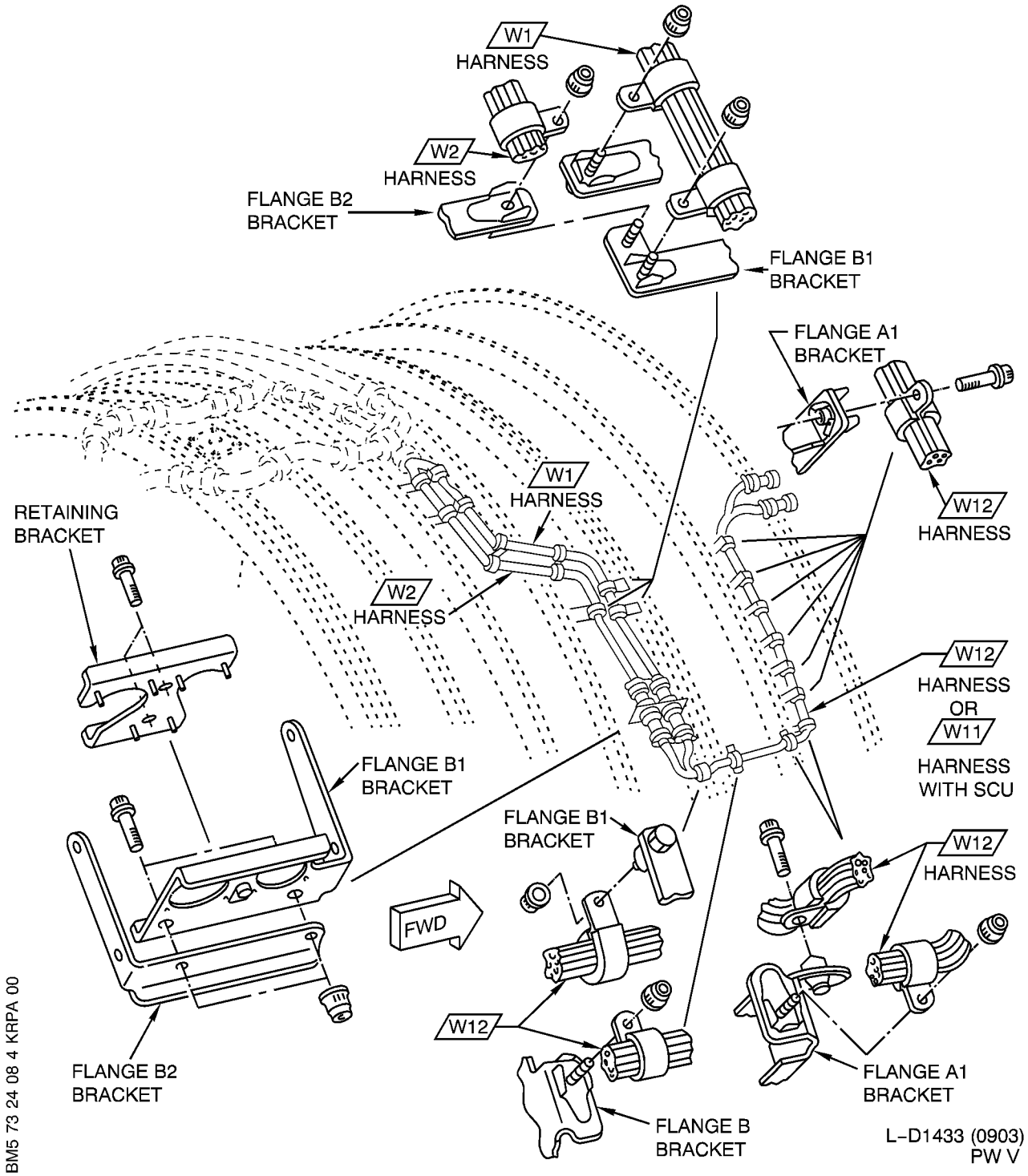
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE R (Sheet 1)
Figure 468



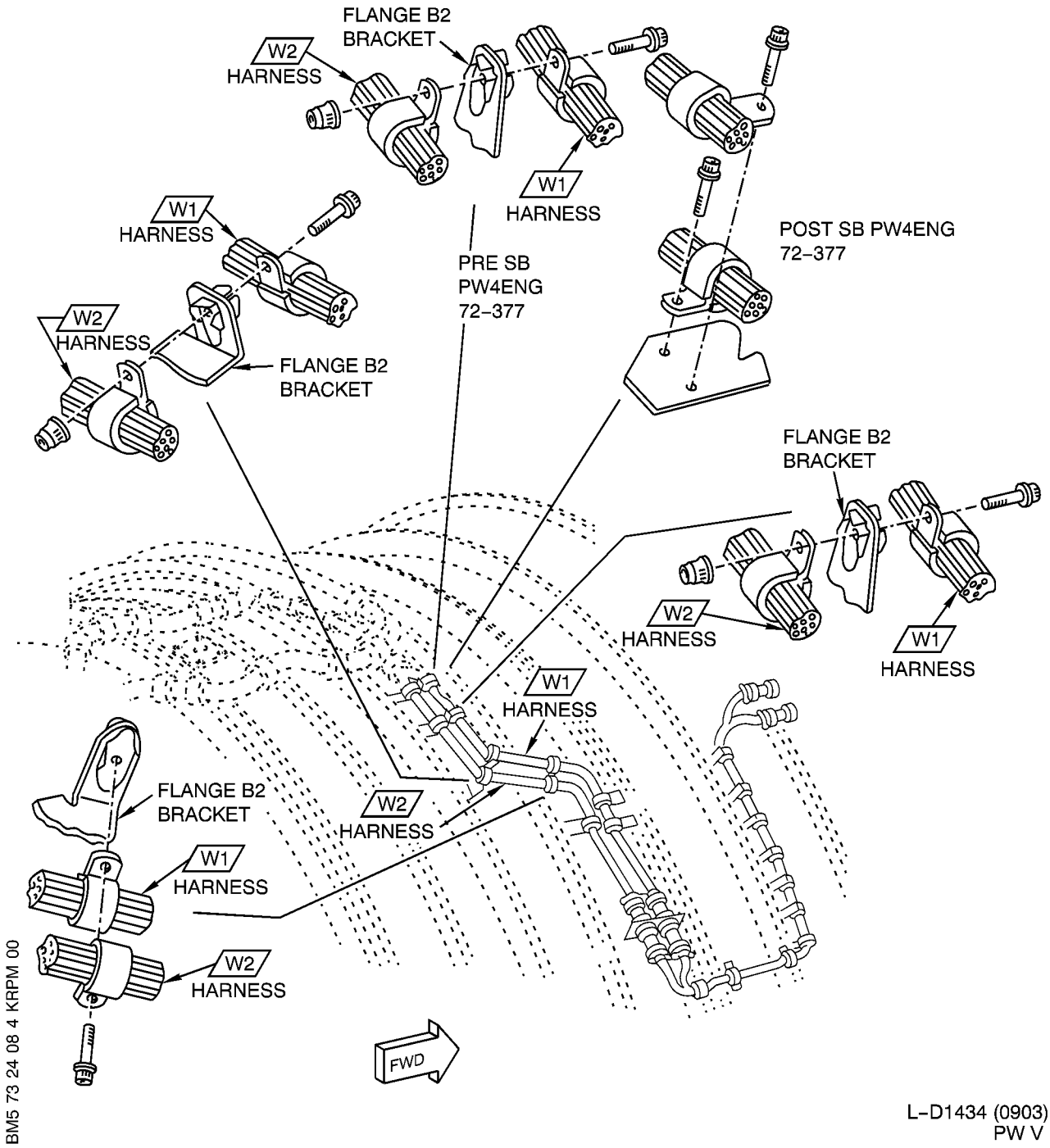
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case) - FIGURE R (Sheet 2)
Figure 468



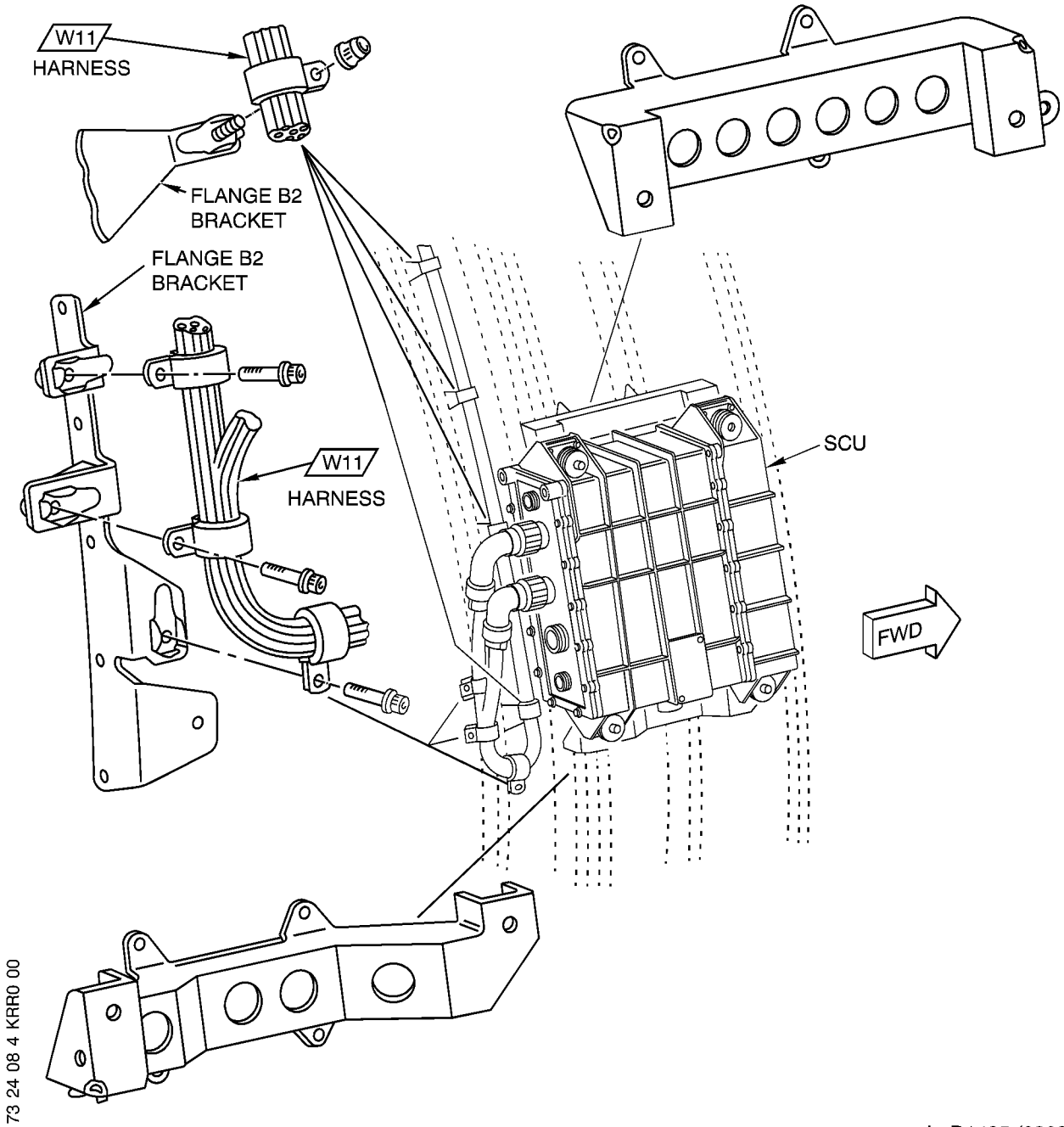
EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE S
Figure 469



EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE V (Sheet 1)
Figure 470



EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE V (Sheet 2)
Figure 470



EEC Wiring Harness - W1, W2, W11 With SCU and W12 (Fan Case)
- FIGURE W
Figure 471

the witness (color) band and the connector coupling nut is hand tight.

NOTE : The witness (color) band is the first band on the receptacle that you cover when you tighten the connector coupling nut.

CAUTION : USE THE CORRECT ASSEMBLY TOOLS. USE OF THE WRONG ASSEMBLY TOOLS CAN RESULT IN CONNECTOR DAMAGE OR A LOOSE CONNECTOR. A LOOSE CONNECTOR PERMITS VIBRATION AND CAN RESULT IN CONTACT WEAR AND POOR LIGHTNING PROTECTION.

(d)Use the Glenair TG-70 strap wrench or the Glenair TG-69 soft-jawed pliers and tighten the connector coupling nut. Use sufficient force to be sure :
- the connector coupling nut is fully tight
- the connector fits tightly against the receptacle (metal to metal)
This procedure will make sure the contacts are sufficiently engaged and the connector is tight.

NOTE : If you use too much force, the tools (above) will turn around on the connector coupling nut. This will prevent too much torque.

NOTE : See the instructions given with the strap wrench for correct use.

(e)Connect the W1P6, W1P7 and W1P8 harness connectors to the J6, J7 and J8 receptacles on the rear side of the EEC (Channel A).

(f)Connect the W2P2, W2P3 and W2P4 harness connectors to the J2, J3 and J4 receptacles on the front side of the EEC (Channel B).

NOTE : Be sure that each of the leads for all the connectors go out of the W1 and W2 harnesses as shown.

(g)Connect the W2P20 harness connector (if equipped) to the receptacle on the PMUX.

(h)Connect the W2P26 harness connector to the W5J26 harness receptacle attached to the HPC case bracket at approximately 12 o'clock position.

(j)Attach the W2J9 harness receptacle to the same HPC case bracket with the retaining bracket and two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(k)Connect the W1P10 and W1P11 harness connectors to the receptacles of the solenoid at approximately 1 o'clock position above Flange E.

(l)Connect the W1P25 harness connector to the W4J25 harness receptacle attached to the HPC case bracket at approximately 1:30 o'clock position.

(m)Connect the W1P9 harness connector to the W2J9 harness receptacle attached to the HPC case bracket at approximately 12 o'clock position.

(n)Connect the W1P24 harness connector to the W3J24 harness receptacle attached to the HPC case bracket at approximately 10 o'clock position.

(7)Attach the simulator panels to fan case as follows (Ref. Fig. 474).

(a)Install a PWA 86157 Pylon Interface Simulator Box to bolt holes 4 and 5, 116 and 117 on Flange B2, removing existing bolts at some locations to attach simulator to the flange. Secure the box to the corresponding bolt holes on Flange A1.

(b)Install a PWA 86158 Electrical Junction Box Simulator to bolt holes 108 through 110 on Flange B1. Secure the box to the flange with the receptacles pointing downward and attach it to the corresponding bolt holes on Flange A1.

(c)Install a PWA 86211 Inlet Cowl Simulator Panel to bolt holes 4 and 5 on

the rear face of Flange A. Secure the panel to the flange with bolts and detail knobs.

(d)Install a PWA 86212 Junction Box Simulator Panel to bolt holes 104 and 106 on Flange A1 and the corresponding bolt holes on Flange B1. Secure the panel to the flange with bolts and washers and if required, spacers between Flange A1 and the panel.

(e)Attach the connector ends of the EEC harnesses to the proper receptacles on the simulators.

(8)Adjust the W1 and W2 harnesses for any necessary clearance as required. Install the clamps at all clamp points. Refer to figures. Attach the clamps loosely to the engine with bolts and/or nuts, threads lubricated with Engine Oil (Material No.P03-001). Remove the Twist Ties (Material No.P05-124) previously installed to position harnesses.

NOTE : Use different clamp sizes on the wiring harnesses to prevent harness movement when tightened. See the Illustrated Parts Catalog for selection of clamp sizes and part numbers.

(9)Attach the harnesses through the intermediate case strut as follows (Ref. Fig. 457).

(a)Make sure the upper front grommet is installed forward of the EEC sensing tubes at the top of the strut.

(b)Install the upper middle and rear grommets to the harnesses at the top of the strut. Install one bolt, threads lubricated with Engine Oil (Material No.P03-001) and washer (Pre SB PW4ENG 72-145) or plate (Post SB PW4ENG 72-145). Tighten the bolt by hand.

(c)Install the lower center grommets and lower right and left clamp segments to the harnesses at the bottom of the strut. Attach each of the clamp segments to the intermediate case with two screws, threads lubricated with Engine Oil (Material No.P03-001) and one bracket. Tighten screws by hand.

(d)Adjust the harnesses through the strut so that the harnesses are not loose. Make sure the marks previously made on each harness align with the rear surface of the clamps that attach the harnesses to the Flange E brackets (Ref. Fig. 473) (Sheet 2).

(e)TORQUE the clamp bolts that attach both harnesses to the intermediate case below the strut and to the Flange E brackets to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN). Remove all looseness from the harnesses through the strut area out the top of the strut.

(f)Tighten the four screws that attach the lower clamp segments. Loosen the screws one turn. TORQUE the screws to 22 lbf.in. (0.25 m.daN) plus the torque required to turn the screw through the locking property. The maximum torque for the screw is 40 lbf.in. (0.45 m.daN). Make sure the remaining screw holes in the clamp segment bracket align with the intermediate case screw holes.

(g)(Reference 2011) Tighten the upper grommet bolt at top of strut until locking property of nut is felt. Tighten bolt 10 complete turns more.

(10)Install a PWA 86159 Vee-band Anchor Fitting Simulator Bar to the outer fan case Vee-groove at the 12 o'clock position. Check the clearance of the harnesses as they cross the Vee-groove and travel under the Vee-band simulator bar. Adjust the harness as required to obtain a proper fit.

(11)Adjust harnesses for clearances and TORQUE all the remaining clamp bolts

to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(12)Tie harnesses and examine clearances as shown in (Ref. Fig. 473).
(13)Remove the EEC and TORQUE the clamp bolts that were under the EEC to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).
(14)Disconnect the harness connectors from the simulator boxes and panels.
(15)Remove the simulators from the engine.
(16)Replace the previously removed bolts, washers and nuts to the open holes in the flange brackets. TORQUE the bolts to between 85 and 95 lbf.in. (0.95 and 1.07 m.daN).
(17)For engines that are post SB PW4ENG 72-161 and have only the fan exit fairing access covers removed, install the acces covers and the rear cover plate as follows. Use a No.10 Torq-set drive (Ref. Fig. 450).
CAUTION : BE SURE TO USE THE CORRECT PART NUMBER ACCESS COVER AND COVER PLATE. INTERCHANGEABILITY IS AFFECTED. REFER TO SB PW4ENG 72-161 AND SB PW4ENG 72-370.
(a)(Post SB PW4ENG 72-370) If the access covers you install are new, bond washers to the two boltholes that are at the bottom of the covers as follows. If the access covers you install are not new, skip this step.
1 Use the washers that were on the covers you removed. Use the same quantity of washer, in the same positions, on the new covers as on the old covers.
NOTE : Refer to the Standard Practices Manual, 70-48, for the cleaning procedures that follow.
2 Clean the areas the sealant will touch with PWA 83-D4, but do not use trichlorotrifluoroethane.
3 With Sealant (Material No.P09-027), make a fillet all around the edges of the washers. Sealant is not permitted between the washers and the intermediate case nor between the washers and the fairing access covers.
4 Cure the sealant in air that is at room temperature and has a relative humidity of 25 percent, for four hours before you touch it.
(b)Install the two access covers to the fan exit fairing with the four screws and two screws and if applicable two screws lubricated with Engine Oil (Material No.P03-001).
(c)Tighten the four screws against the two covers and then loosen them one complete turn. Tighten the four screws and against the two covers and then loosen them one complete turn.
(d)Install the (rear) cover plate to the fan exit fairing with the six screws, lubricated with Engine Oil (Material No.P03-001).
(e)Tighten the screws against the cover plate then loosen them one complete turn. TORQUE the screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN).
(f)TORQUE the four screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN).
(g)TORQUE the four screws and two screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN).
(18)Apply sealant to Area AL (Ref. Fig. 475).
NOTE : Refer to the Standard Practices Manual, 70-48, for the cleaning

procedures that follow.

(a)Clean the areas the sealant will touch. Use PWA 83-D4, but do not use trichlorotrifluoroethane.

(b)Apply Primer (Material No.P18-007) to all cleaned surfaces.

1 It is necessary to apply the primer in less than two hours after you cleaned the area.

2 The primer must cure in air at ambient temperature for two hours, minimum. The air must have a relative humidity of 25 percent, minimum.

(c)Apply Sealant (Material No.P09-019).

1 It is necessary to apply the sealant from 2 to 24 hours after you applied the primer.

2 Use a hot air gun at 175 to 225 deg.F (79 to 107 deg.C) for 5 to 7 minutes to dry the sealant.

3 After the hot air gun, cure the sealant in air that has a relative humidity of 25 percent, minimum, for eight hours, minimum, before you touch the parts.

(19)Apply sealant to Area AM :

(a)Clean the areas the sealant will touch. Use PWA 83-D4, but do not use trichlorotrifluoroethane.

(b)Apply Sealant (Material No.P09-027). Cure the sealant in air that is at room temperature and has a relative humidity of 25 percent, minimum, for eight hours, minimum, before you touch the parts.

D. Close-Up

(1)For engines with the fan exit fairings disassembled from the intermediate case, install the fairings (Ref. 72-23-06, P. Block 401).

(2)Install the fan exit liner segments (inner rear) that you removed (Ref. 72-23-05, P. Block 401).

(3)Install the electronic engine control (EEC) (Ref. 73-21-01, P. Block 401).

4. Install EEC Fan Case Wiring Harnesses W1, W2, W11 and W12 for Engines With a Supplemental Control Unit (SCU)

NOTE : This procedure provides for installation of the EEC fan case wiring harnesses W1, W2, W11 (SCU only) and W12 when the fan case is installed to the intermediate case.

A. Job Set-Up

(1)If it is necessary to install a new access cover, (Ref. 72-23-06, P. Block 801) for instructions on the installation of boltholes in the access cover.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Glenair TG-70 Strap Wrench or Glenair TG-69 Soft Jawed Pliers
(2)	No.10 Torq-set Drive
(3)PWA 86211	Panel, Simulator

ITEM	DESIGNATION
(4)PWA 86212	Panel, Simulator
(5)Material No.P03-001	Oil, Engine (PWA 521B)
(6)Material No.P05-099	Tape, Moisture Resistant, Green (PMC4141)
(7)Material No.P05-124	Ties, Twist
(8)Material No.P09-019	Sealant, Flame Resistant Silicone Rubber (PWA 36751-1)
(9)Material No.P09-027	Sealant, Silicone Rubber (PWA 36003-2)
10)Material No.P11-009	Alcohol, Denatured Ethyl (AMS 3002)
11)Material No.P18-007	Primer, Silicone (PWA 36086-2)
Referenced Procedures	
- 72-23-05, P. Block 401	Fan Exit Liner Segments
- 72-23-06, P. Block 401	Fan Exit (Bifurcation) Fairing
- 72-23-06, P. Block 801	Fan Exit (Bifurcation) Fairing
- 73-21-01, P. Block 401	Full Authority Digital Engine

C. Procedure (Ref. Fig. 460, 461, 462)
(Ref. Fig. 463, 468, 459)
(Ref. Fig. 467, 466, 465)
(Ref. Fig. 464, 470, 471)

CAUTION : DO NOT TWIST OR BEND THE HARNESSES BADLY DURING THE INSTALLATION OR DAMAGE TO THE HARNESSES CAN RESULT.

(1)Install the (inboard) clamp segment at the 10 o'clock position between Flanges B1 and B2. Attach the clamp segment to the flange brackets with two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 464).

(2)Put the W1 and W2 wiring harnesses on the left side of the fan case and down through the intermediate case strut at the 12 o'clock position. Keep the W1 harness to the right of the strut and the W2 harness to the left of the strut (Ref. Fig. 460, 461) for the routing of the harness.

(3)Adjust the harness positions and install Twist Ties (Material No.P05-124) to temporarily attach the harnesses to the engine brackets.

(4)Temporarily install the EEC over the harnesses and attach to the fan case brackets with work bolts.

(5)Temporarily connect the W1 and W2 harness connectors (given below) to the mating harness receptacles as follows (Ref. Fig. 462, 463). For each connector :

CAUTION : IF ENGINE HAS THE HPC RING CASE CONFIGURATION (POST SB PW4ENG 72-756), MAKE SURE YOU INSTALL THE CORRECT W1 AND W2 HARNESSES, PROGRAMMING PLUG AND EEC. IF YOU DO NOT INSTALL THE CORRECT HARDWARE, THE ENGINE WILL NOT OPERATE.

(a)If W1 and W2 harnesses have yellow bands, you must have an EEC with the yellow and black label (For Ring Case Configuration) (Ref. Fig. 472).

(b)Remove the protection covers. Examine the harness connector and the mating receptacle for bent pins and contamination. If necessary, carefully make straight any bent pins. If necessary, clean the connector and receptacle with Denatured Ethyl Alcohol (Material No.P11-009). Let dry.

(c)Align the connector keyways and engage the connector to the mating receptacle. Tighten the connector coupling nut by hand until you cover the witness (color) band and the connector coupling nut is hand tight.
NOTE : The witness (color) band is the first band on the receptacle that you cover when you tighten the connector coupling nut.
CAUTION : USE THE CORRECT ASSEMBLY TOOLS. USE OF THE WRONG ASSEMBLY TOOLS CAN RESULT IN CONNECTOR DAMAGE OR A LOOSE CONNECTOR. A LOOSE CONNECTOR PERMITS VIBRATION AND CAN RESULT IN CONTACT WEAR AND POOR LIGHTNING PROTECTION.

(d)Use the Glenair TG-70 strap wrench or the Glenair TG-69 soft-jawed pliers and tighten the connector coupling nut. Use sufficient force to be sure :
- the connector coupling nut is fully tight
- the connector fits tightly against the receptacle (metal to metal)
This procedure will make sure the contacts are sufficiently engaged and the connector is tight.
NOTE : If you use too much force, the tools (above) will turn around on the connector coupling nut. This will prevent too much torque.
NOTE : See the instructions given with the strap wrench for correct use.

(e)Connect the W1P6, W1P7 and W1P8 harness connectors to the J6, J7 and J8 receptacles on the rear side of the EEC (Channel A).

(f)Connect the W2P2, W2P3 and W2P4 harness connectors to the J2, J3 and J4 receptacles on the front side of the EEC (Channel B).
NOTE : Be sure that each of the leads for all the connectors go out of the W1 and W2 harnesses as shown.

(6)Adjust the W2 harness from the clamp segment (under EEC) to the three connectors on the EEC. At the 9:30 o'clock position install two clamps on the harness, one clamp to a bracket on Flange A1 and one clamp to a bracket on Flange B1. Attach clamps to brackets with nuts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the nuts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 464).

(7)Adjust the W1 harness from the clamp segment (under EEC) to the three connectors on the EEC. At the 9:30 o'clock position install two clamps on the harness, one clamp to a bracket on Flange B1 and one clamp to a bracket on Flange B2. Upward from the last installed clamps, install four clamps on the harness, three clamps to brackets on Flange C and one small clamp to a bracket on Flange B2. Attach clamps to brackets with bolts and/or nuts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts and /or nuts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 464).

(8)Disconnect the six connectors from the EEC receptacles. Remove the EEC from the fan case.

(9)Adjust the W1 and W2 harnesses through the (inboard) clamp segment at the 10 o'clock position. Install the (outboard) clamp segment over the harnesses and to the (inboard) clamp segment. Attach segments together with bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 471).

(10)Connect the W1 and W2 harness connectors (given below) to the mating

harness receptacles as follows (Ref. Fig. 464, 450). For each connector :

(a) Remove the protection covers. Examine the harness connector and the mating receptacle for bent pins and contamination. If necessary, carefully make straight any bent pins. If necessary, clean the connector and receptacle with Denatured Ethyl Alcohol (Material No.P11-009). Let dry.

(b) Align the connector keyways and engage the connector to the mating receptacle. Tighten the connector coupling nut by hand until you cover the witness (color) band and the connector coupling nut is hand tight.

NOTE : The witness (color) band is the first band on the receptacle that you cover when you tighten the connector coupling nut.

CAUTION : USE THE CORRECT ASSEMBLY TOOLS. USE OF THE WRONG ASSEMBLY TOOLS CAN RESULT IN CONNECTOR DAMAGE OR A LOOSE CONNECTOR. A LOOSE CONNECTOR PERMITS VIBRATION AND CAN RESULT IN CONTACT WEAR AND POOR LIGHTNING PROTECTION.

(c) Use the Glenair TG-70 strap wrench or the Glenair TG-69 soft-jawed pliers and tighten the connector coupling nut. Use sufficient force to be sure :
- the connector coupling nut is fully tight
- the connector fits tightly against the receptacle (metal to metal)
This procedure will make sure the contacts are sufficiently engaged and the connector is tight.

NOTE : If you use too much force, the tools (above) will turn around on the connector coupling nut. This will prevent too much torque.

NOTE : See the instructions given with the strap wrench for correct use.

(d) Connect the W1P6, W1P7 and W1P8 harness connectors to the J6, J7 and J8 receptacles on the rear side of the EEC (Channel A).

(e) Connect the W2P2, W2P3 and W2P4 harness connectors to the J2, J3 and J4 receptacles on the front side of the EEC (Channel B).

(f) Connect the W2P26 harness connector to the W5J26 harness receptacle attached to the HPC case bracket at approximately 12 o'clock position.

(g) Attach the W2J9 harness receptacle to the same HPC case bracket with the retaining bracket and two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(h) Connect the W1P10 and W1P11 harness connectors to the receptacles of the solenoid at approximately 1 o'clock position above Flange E.

(j) Connect the W1P25 harness connector to the W4J25 harness receptacle attached to the HPC case bracket at approximately 1:30 o'clock position.

(k) Connect the W1P9 harness connector to the W2J9 harness receptacle attached to the HPC case bracket at approximately 12 o'clock position.

(l) Connect the W1P24 harness connector to the W3J24 harness receptacle attached to the HPC bracket at approximately 10 o'clock position.

(m) Install W1J36 and W2J37 harness receptacles to a bracket between Flanges B1 and B2 at approximately the 1:30 o'clock position. Attach the receptacles to the bracket with a retaining bracket and two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the

bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN) (Ref. Fig. 470).

(11)Attach the fan case simulator panels as follows (Ref. Fig. 476).

(a)Install a PWA 86211 Inlet Cowl Simulator Panel to bolts holes 4 and 5 on the rear face of Flange A. Secure the panel to the flange with bolts and detail knobs.

(b)Install a PWA 86212 Junction Box Simulator Panel to bolt holes 104 and 106 on Flange A1 and the corresponding bolt holes on Flange B1. Secure the panel to the flange with bolts and washers and if required, spacers between Flange A1 and the panel.

(c)Attach the connector ends of the EEC harness to the receptacles on the simulators. Adjust the harness as necessary to obtain the proper fits and clearances.

(12)Adjust the remaining portion of the W1 and W2 harnesses for any necessary clearance as required. Install the clamps at the remaining clamp points. Refer to figures. Attach the clamps loosely to the engine with bolts and/or nuts, threads lubricated with Engine Oil (Material No.P03-001). Remove the Twist Ties (Material No.P05-124) previously installed to position harnesses.

NOTE : Use different clamp sizes on the wiring harnesses to prevent harness movement when tightened. See the Illustrated Parts Catalog for selection of clamp sizes and part numbers.

(13)Attach the harnesses through the intermediate case strut as follows (Ref. Fig. 467).

(a)Make sure the upper front grommet is installed forward of the EEC sensing tubes at the top of the strut.

(b)Install the upper middle and rear grommets to the harnesses at the top of the strut. Install one bolt, threads lubricated with Engine Oil (Material No.P03-001), and plate. Tighten the bolt by hand.

(c)Install the lower center grommets and lower right and left clamp segments to the harnesses at the bottom of the strut. Attach each of the clamp segments to the intermediate case with two screws, threads lubricated with Engine Oil (Material No.P03-001) and one bracket. Tighten screws by hand.

(d)Adjust the harnesses through the strut so that the harnesses are not loose.

(e)TORQUE the clamp bolts that attach both harnesses to the intermediate case below the strut and to the Flange E brackets to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN). Remove all looseness from the harnesses through the strut area out the top of the strut.

(f)Tighten the four screws that attach the lower clamp segments. Loosen the screws one turn. TORQUE the screws to 22 lbf.in. (0.25 m.daN) plus the torque required to turn the screw through the locking property. The maximum torque for the screw is 40 lbf.in. (0.45 m.daN). Make sure the remaining screw holes in the clamp segment bracket align with the intermediate case screw holes.

(g)(Reference 2011) Tighten the upper grommet bolt at top of strut until locking property of nut is felt. Tighten bolt 10 complete turns more.

(14)Adjust the W1 and W2 harnesses for clearances. TORQUE the remaining bolts and/or nuts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(15)Disconnect the harness connectors from the simulator panels. Remove the

panels from the engine.

(16)For engines without the supplemental control unit (SCU), install the W12 wiring harness on the upper right side of the fan case as follows (Ref. Fig. 470).

(a)Connect the W12P37 harness connector to the W1J36 harness receptacles at the 1:30 o'clock position.

1 Remove the protection covers. Examine the harness connector and the mating receptacle for bent pins and contamination. If necessary, carefully make straight any bent pins. If necessary, clean the connector and receptacle with Denatured Ethyl Alcohol (Material No.P11-009). Let dry.

2 Align the connector keyways and engage the connector to the mating receptacle. Tighten the connector coupling nut by hand until you cover the witness (color) band and the connector coupling nut is hand tight.

NOTE : The witness (color) band is the first band on the receptacle that you cover when you tighten the connector coupling nut.

CAUTION : USE THE CORRECT ASSEMBLY TOOLS. USE OF THE WRONG ASSEMBLY TOOLS CAN RESULT IN CONNECTOR DAMAGE OR A LOOSE CONNECTOR. A LOOSE CONNECTOR PERMITS VIBRATION AND CAN RESULT IN CONTACT WEAR AND POOR LIGHTNING PROTECTION.

3 Use the Glenair TG-70 strap Wrench or the Glenair TG-69 soft-jawed pliers and tighten the connector coupling nut. Use sufficient force to be sure :
- the connector coupling nut is fully tight
- the connector fits tightly against the receptacle (metal to metal)
This procedure will make sure the contacts are sufficiently engaged and the connector is tight.

NOTE : If you use too much force, the tools (above) will turn around on the connector coupling nut. This will prevent too much torque. See the instructions given with the strap wrench for correct use.

(b)Adjust the harness and install clamps to the harness. Attach the clamps to brackets with bolts and/or nuts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts and/or nuts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(17)For engines with the supplemental control unit (SCU), install the W11 wiring harness on the upper right side of the fan case as follows (Ref. Fig. 471).

(a)Connect the W11 harness connectors (given below) to the mating harness receptacles as follows. For each connector :

1 Remove the protection covers. Examine the harness connector and the mating receptacle for bent pins and contamination. If necessary, carefully make straight any bent pins. If necessary, clean the connector and receptacle with Denatured Ethyl Alcohol (Material No.P11-009). Let dry.

2 Align the connector keyways and engage the connector to the mating receptacle. Tighten the connector coupling nut by hand until you cover the witness (color) band and the connector coupling nut is hand tight.

NOTE : The witness (color) band is the first band on the receptacle that you cover when you tighten the connector coupling nut.

CAUTION : USE THE CORRECT ASSEMBLY TOOLS. USE OF THE WRONG ASSEMBLY

TOOLS CAN RESULT IN CONNECTOR DAMAGE OR A LOOSE CONNECTOR. A LOOSE CONNECTOR PERMITS VIBRATION AND CAN RESULT IN CONTACT WEAR AND POOR LIGHTNING PROTECTION.

3 Use the Glenair TG-70 strap Wrench or the Glenair TG-69 soft-jawed pliers and tighten the connector coupling nut. Use sufficient force to be sure :
- the connector coupling nut is fully tight
- the connector fits tightly against the receptacle (metal to metal)
This procedure will make sure the contacts are sufficiently engaged and the connector is tight.

NOTE : If you use too much force, the tools (above) will turn around on the connector coupling nut. This will prevent too much torque. See the instructions given with the strap wrench for correct use.

(b)Connect the W11P37 connector to the W2J37 receptacle and connect the W11P36 connector to the W1J36 receptacle located at the 1:30 o'clock position.

(c)Connect the W11P34 connector to the J2 receptacle and the W11P33 connector to the J3 receptacle on the SCU.

(d)Install the W11J32 harness receptacle to a bracket on Flange B1 at the 3 o'clock position. Attach the receptacle to the bracket with a retaining bracket and two bolts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(e)Adjust the harness and install clamps to the harness. Attach the clamps to brackets with bolts and/or nuts, threads lubricated with Engine Oil (Material No.P03-001). TORQUE the bolts and/or nuts to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

(18)Install the fan exit fairing access covers and the rear cover plate as follows. Use a No.10 Torq-set drive (Ref. Fig. 450).

CAUTION : BE SURE TO USE THE CORRECT PART NUMBER ACCESS COVER AND COVER PLATE. INTERCHANGEABILITY IS AFFECTED. REFER TO SB PW4ENG 72-161 AND SB PW4ENG 72-370.

(a)(Post SB PW4ENG 72-370) If the access covers you install are new, bond washers to the two boltholes that are at the bottom of the covers as follows. If the access covers you install are not new, skip this step (Ref. Fig. 450).

1 Use the washers that were on the covers you removed. Use the same quantity of washer, in the same positions, on the new covers as on the old covers.

NOTE : Refer to the Standard Practices Manual, 70-48, for the cleaning procedures that follow.

2 Clean the areas the sealant will touch with PWA 83-D4, but do not use trichlorotrifluoroethane.

3 With Sealant (Material No.P09-027), make a fillet all around the edges of the washers. Sealant is not permitted between the washers and the intermediate case nor between the washers and the fairing access covers.

4 Cure the sealant in air that is at room temperature and has a relative humidity of 25 percent, for four hours before you touch it.

(b)Install the two access covers to the fan exit fairing with the four

screws, two screws (Ref. Fig. 450) and if applicable two screws, lubricated with Engine Oil (Material No.P03-001).

(c)Tighten the four screws against the two covers and then loosen them one complete turn. Tighten the four screws and against the two covers and then loosen them one complete turn (Ref. Fig. 450).

(d)Install the (rear) cover plate to the fan exit fairing with the six screws, lubricated with Engine Oil (Material No.P03-001) (Ref. Fig. 450).

(e)Tighten the screws against the cover plate then loosen them one complete turn. TORQUE the screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN) (Ref. Fig. 450).

(f)TORQUE the four screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN) (Ref. Fig. 450).

(g)TORQUE the four screws and two screws to 22 lbf.in. (0.25 m.daN) plus the torque necessary to turn them through the locking feature of the nuts. The maximum torque is 40 lbf.in. (0.45 m.daN) (Ref. Fig. 450).

(19)Apply sealant to Area AL (Ref. Fig. 475).

NOTE : Refer to the Standard Practices Manual, 70-48, for the cleaning procedures that follow.

(a)Clean the areas the sealant will touch. Use PWA 83-D4, but do not use trichlorotrifluoroethane.

(b)Apply Primer (Material No.P18-007) to all cleaned surfaces.

1 It is necessary to apply the primer in less than two hours after you cleaned the area.

2 The primer must cure in air at ambient temperature for two hours, minimum. The air must have a relative humidity of 25 percent, minimum.

(c)Apply Sealant (Material No.P09-019).

1 It is necessary to apply the sealant from 2 to 24 hours after you applied the primer.

2 Use a hot air gun at 175 to 225 deg.F (79 to 107 deg.C) for 5 to 7 minutes to dry the sealant.

3 After the hot air gun, cure the sealant in air that has a relative humidity of 25 percent, minimum, for eight hours, minimum, before you touch the parts.

(20)Apply sealant to Area AM :

(a)Clean the areas the sealant will touch. Use PWA 83-D4, but do not use trichlorotrifluoroethane.

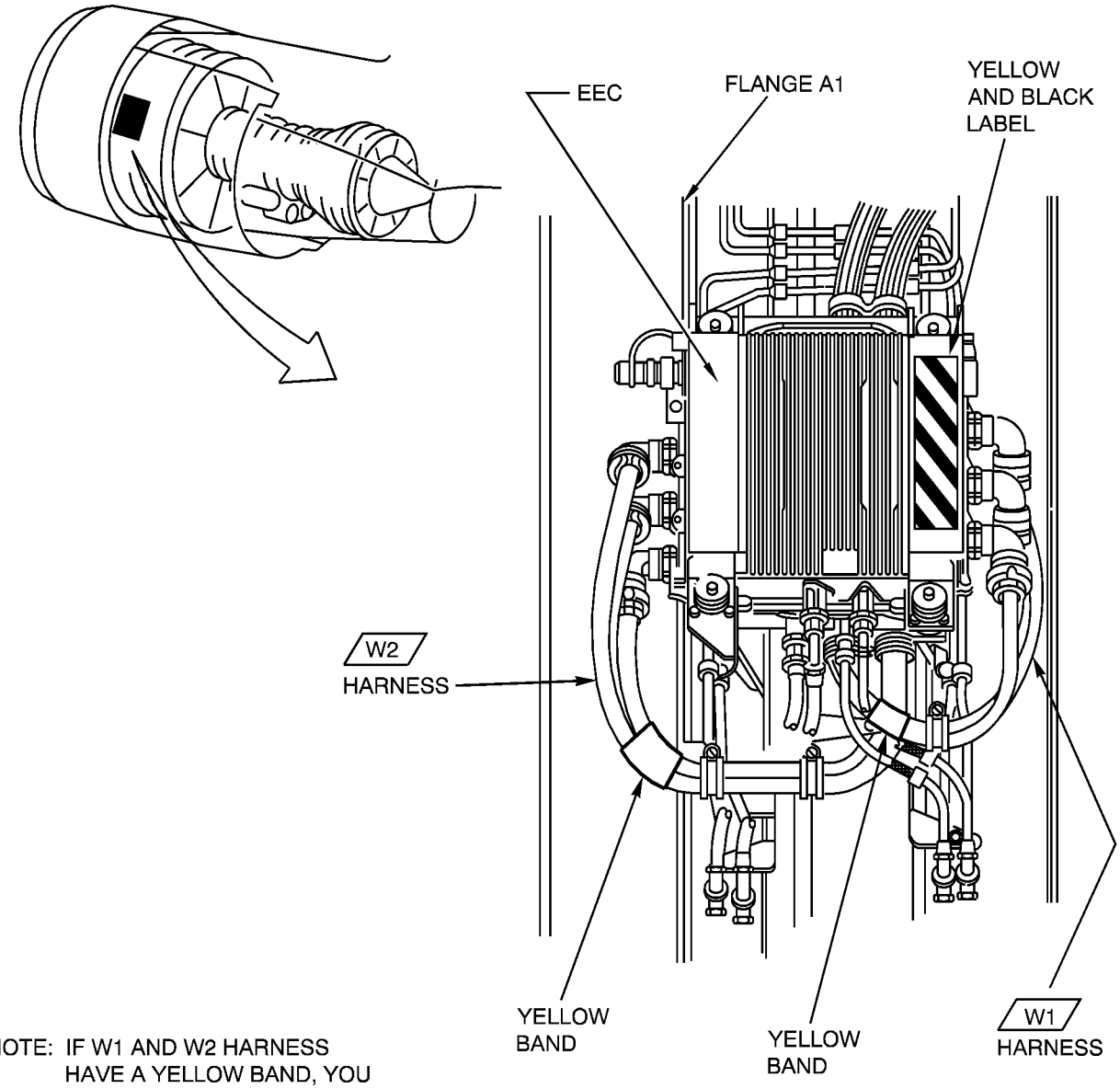
(b)Apply Sealant (Material No.P09-027). Cure the sealant in air that is at room temperature and has a relative humidity of 25 percent, minimum, for eight hours, minimum, before you touch the parts.

D. Close-Up

(1)For engines with the fan exit fairings disassembled from the intermediate case, install the fairings (Ref. 72-23-06, P. Block 401).

(2)Install the fan exit liner segments (inner rear) that you removed (Ref. 72-23-05, P. Block 401).

(3)Install the electronic engine control (EEC) (Ref. 73-21-01, P. Block 401).

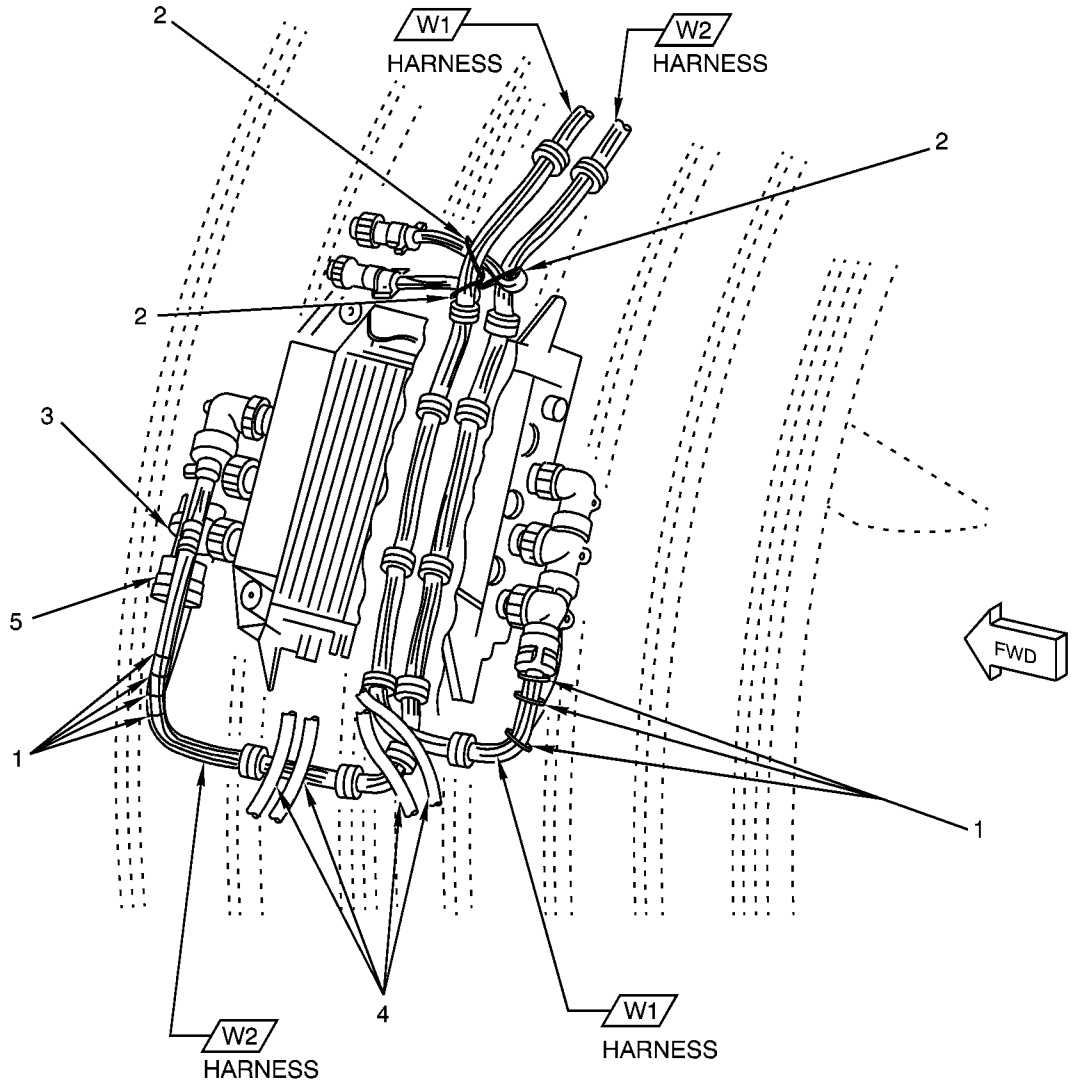


NOTE: IF W1 AND W2 HARNESS HAVE A YELLOW BAND, YOU MUST HAVE THE EEC WITH THE YELLOW AND BLACK LABEL FOR RING CASE CONFIGURATION.
(POST SB PW4ENG 72-756)

BM5 73 24 08 4 KRT0 00

L-D1437 (0903)
PW V

EEC Fan Case Wiring Harnesses - Post SB PW4ENG 72-756
(Ring Case Configuration) Without SCU
Figure 472

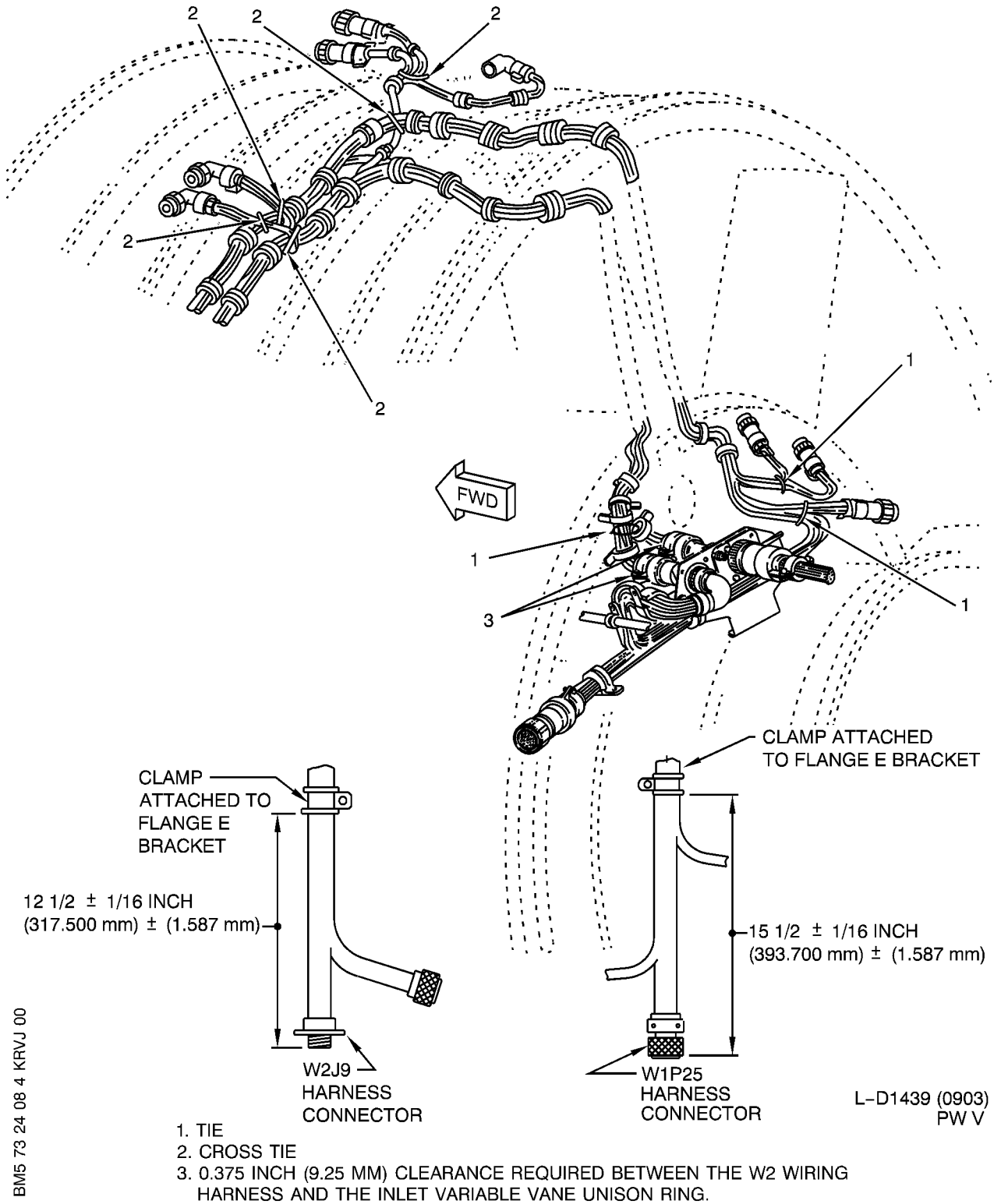


L-D1438 (0903)
PW V

BM5 73 24 08 4 KRVA 00

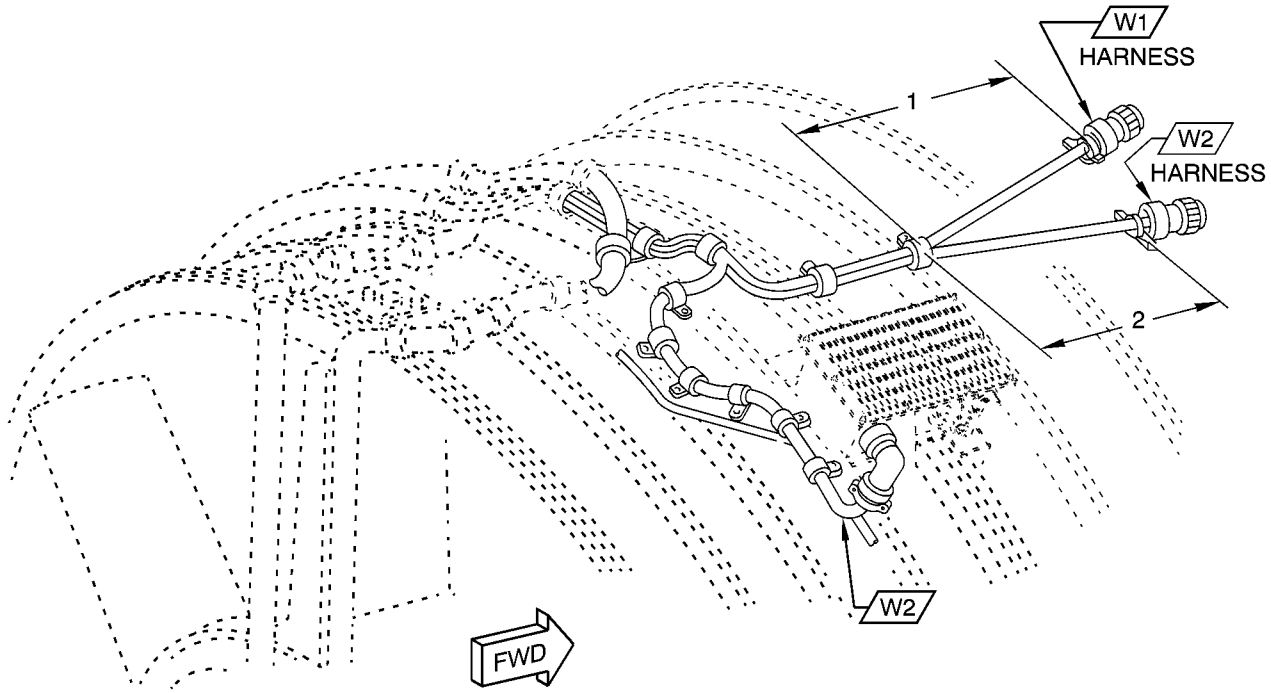
1. TIE
2. CROSS TIE
3. HARNESS MUST BE INBOARD OF THE OUTER SURFACE OF THE EEC
4. 0.375 INCH (9.25 MM) MINIMUM CLEARANCE REQUIRED BETWEEN THE HARNESS AND THE FLEX HOSES.
5. 0.380 INCH (9.652 MM) MINIMUM CLEARANCE REQUIRED BETWEEN THE W2 HARNESS AND THE W2P4 CONNECTOR SCREWS.

EEC Fan Case Wiring Harnesses Without SCU (Sheet 1)
Figure 473



1. TIE
2. CROSS TIE
3. 0.375 INCH (9.25 MM) CLEARANCE REQUIRED BETWEEN THE W2 WIRING HARNESS AND THE INLET VARIABLE VANE UNISON RING.

EEC Fan Case Wiring Harnesses Without SCU (Sheet 2)
Figure 473

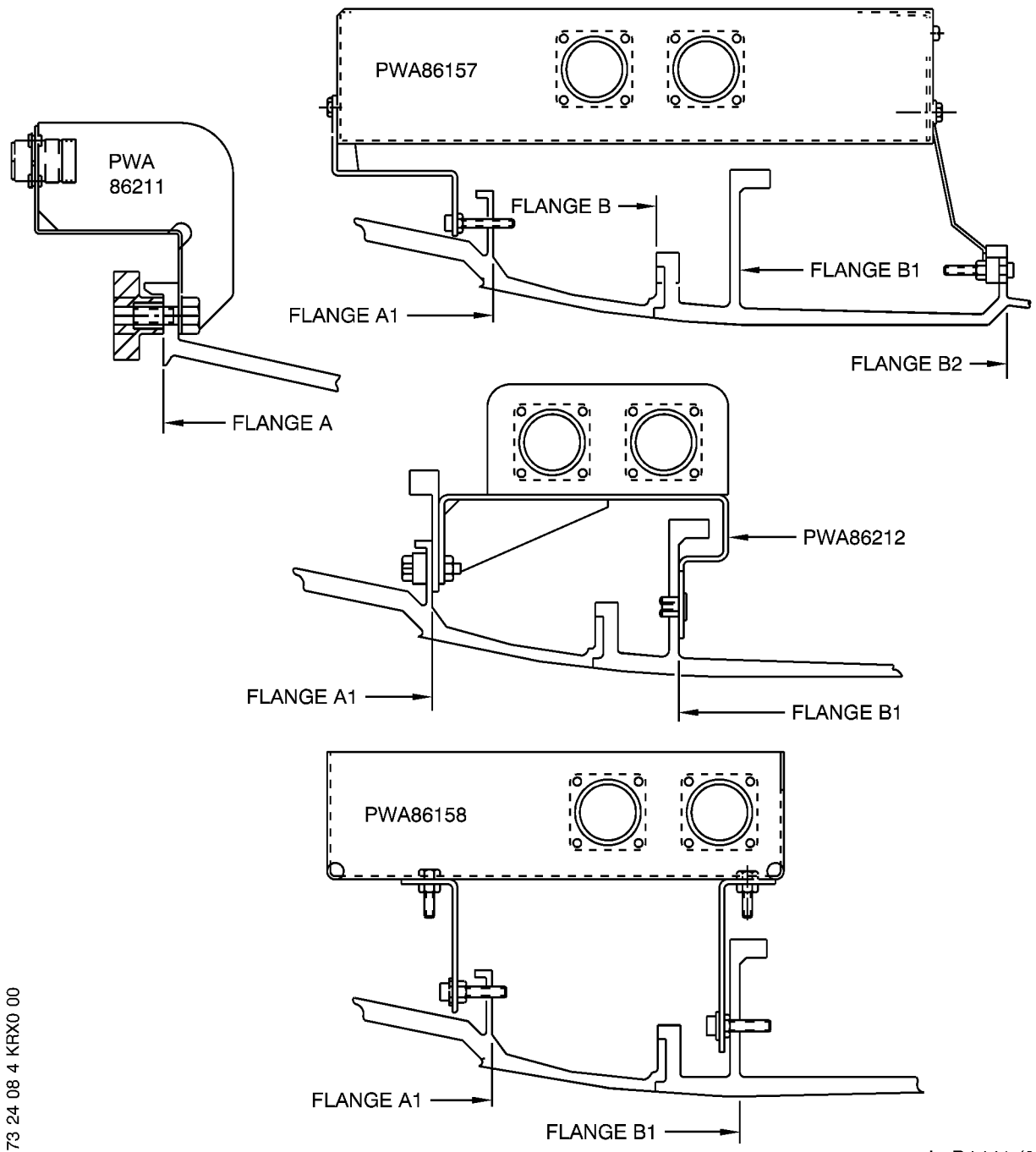


L-D1440 (0903)
PW V

BM5 73 24 08 4 KRVS 00

1. 8.750 - 9.250 INCH (222.250 - 234.950 MM) BETWEEN CLAMP CENTER AND CONNECTOR SCREWS.
2. 7.500 - 8.000 INCH (190.500 - 203.200 MM) BETWEEN CLAMP CENTER AND CONNECTOR SCREWS.

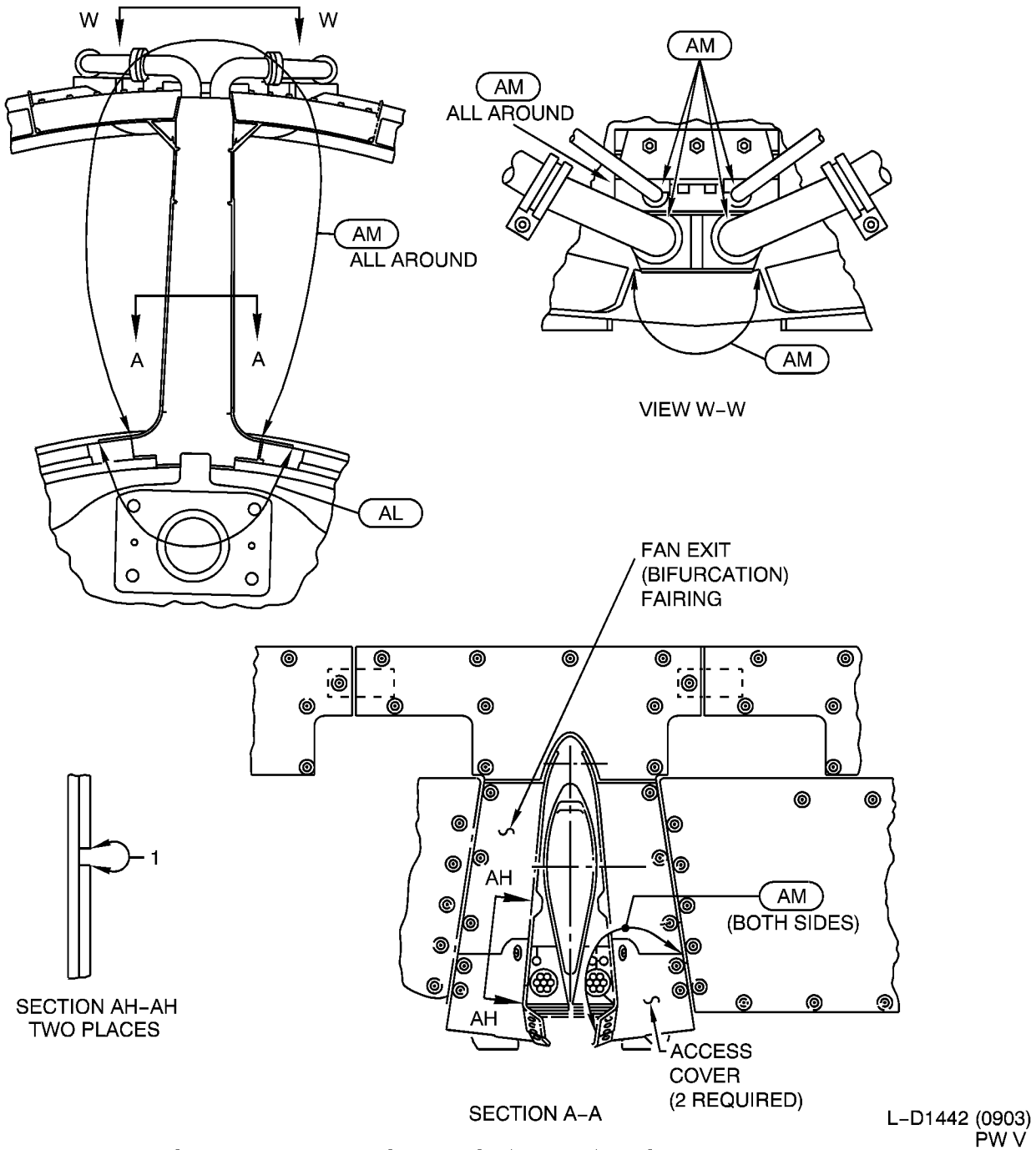
Fan Case W1 and W2 Wiring Harnesses Without SCU (Sheet 3)
Figure 473



BM5 73 24 08 4 KRX0 00

L-D1441 (0903)
PW V

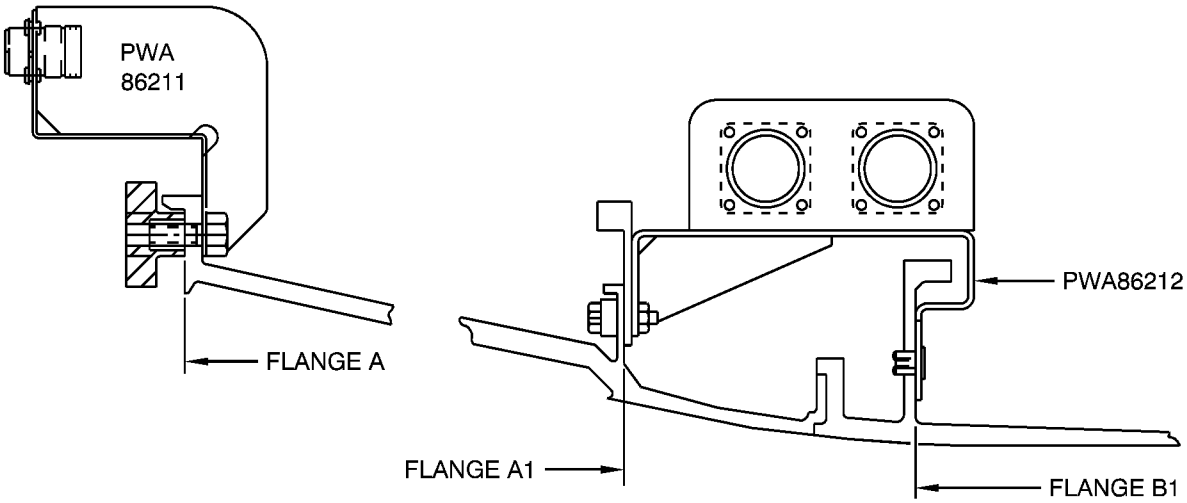
Fan Case Harness Junction Simulators
Figure 474



BM5 73 24 08 4 KRZ0 00

1. APPLY THE SEALANT EVEN WITH, TO 0.010 INCH (0.254 MM) BELOW, TWO PLACES.

Fan Exit Fairing (Bifurcation) Sealant Areas
Figure 475



BM5 73 24 08 4 KSA0 00

L-D1446 (0903)
PW V

Fan Case Harness Junction Simulators
Figure 476

FADEC SPEED TRANSDUCER (N1)/MULTIPLEXER INPUT PROBE - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 001)

A. The probe assembly measures three different parameters :
Low rotor speed (N1), station 2.5 total pressure and station 2.5 total temperature.

(1)Motional pickup (FADEC (N1) speed transducer)

(a)The speed transducer portion of the probe is located at the end of the probe furthest from the mounting flange. The transducer consists of a permanent magnet, two electrically independent pickup coils and two ferromagnetic coil cores ; all enclosed in a non-magnetic steel case. The output signals are carried by two pairs of shielded insulated wires which terminate at an electrical connector on the mounting flange.

(2)Total temperature (TT2.5)

(a)The total temperature portion of the probe is located in a cavity within the instrumentation sleeve. The air temperature is sensed by four thermocouples located within four ports on the leading edge of the sleeve. Sampled air leaves the probe by means of eight exhaust holes on each side of the airfoil. Thermocouple temperature is average within the internal wiring that is terminated at an electrical connector on the mounting flange.

(3)Total pressure (PT2.5)

(a)The total pressure portion is also located within the instrumentation sleeve. Air enters the pressure sensing cavity by means of five ports located on the leading edge of sleeve station 2.5 total pressure is transmitted to the Propulsion Multiplexer via a tube connector located on the mounting flange.

2. Operation

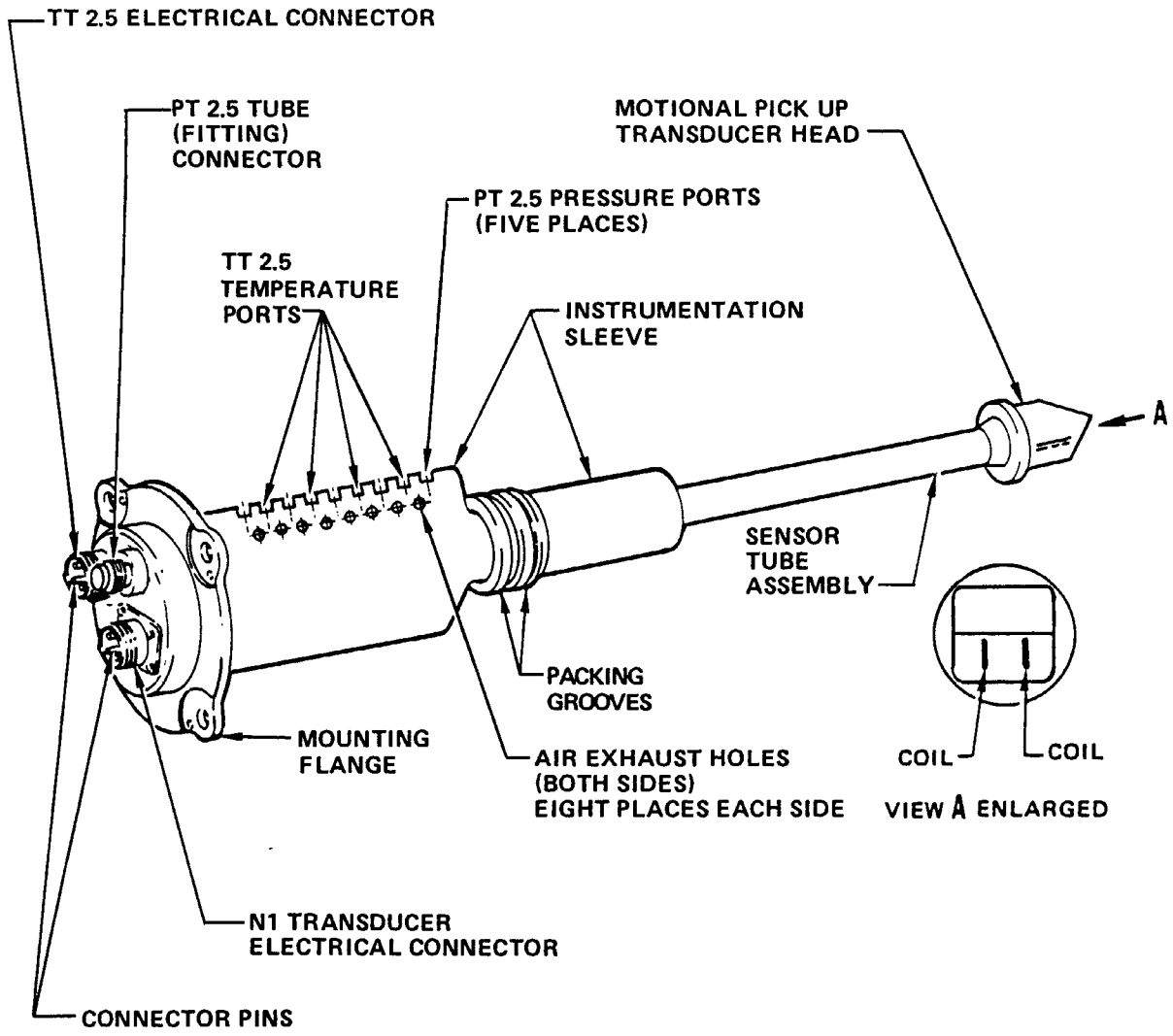
A. Speed Transducer (N1)

(1)The transducer is mounted in close proximity to and is excited by ferromagnetic teeth on the low rotor shaft. The signal is picked up by two ferromagnetic coil cores which serve as the pole pieces. Two identical and independent output frequency signals are generated. The output voltage of each coil is a minimum 1.0 volts peak to peak over a speed range 200-4400 rpm. Each output is used by its dedicated channel of the FADEC.

(a)An open or short circuit in one coil will not prevent the other coil from producing the specified output voltage under all speed and environmental conditions.

B. Total Temperature and Pressure (TT2.5 and PT2.5)

(1)The outputs of the temperature and pressure probes are used by the propulsion multiplexer.



BM5 73 24 09 0 KAMO - 00

Fadec Speed Transducer (N1)/Multiplexer Input Probe
Figure 001

FADEC SPEED TRANSDUCER (N1) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Corrosion Resistant Steel Lockwire (AS3214-02) (Ref. 70-00-00)
C.	Key Washer
D.	Packings
E.	Protective Closures
F.	Jackscrews (0.190-32) (Post SB PW4ENG 73-88)
G. PWA101359	Puller, Mechanical (Pre SB PW4ENG 73-88)
H. Material No.P03-001	Oils (Ref. 70-00-00)
I. Material No.P05-038	Special Materials (Ref. 70-00-00)
J. Material No.P06-002	Lubricants (Ref. 70-00-00)
K. Material No.P06-015	Lubricants (Ref. 70-00-00)
L. Material No.P09-014	Sealants (Ref. 70-00-00)

Referenced Procedures

- 70-00-00, P. Block 201	Standard Practices
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 72-23-05, P. Block 401	Fan Exit Liner Segments

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
FOR ENGINE 1			
133VU	ENG1/SCU SUPPLY GND	35KS	333/T76
133VU	ENG1/SCU SUPPLY FLT	37KS	333/T75
FOR ENGINE 2			
133VU	ENG2/SCU SUPPLY GND	34KS	333/T85
133VU	ENG2/SCU SUPPLY FLT	36KS	333/T84

(2)Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

(3)Remove the fan exit liner segment (inner rear) that is at 5 o'clock (Ref. 72-23-05, P. Block 301).

B. Removal (Ref. Fig. 401)

(1)Disconnect W4P19 and W4P23 harness connectors from transducer probe.

(2)Remove lockwire and disconnect tube nut from transducer probe.

(3)Remove bolt and clamp securing tube to Flange E bracket at approximately 5 o'clock position.

(4)If equipped, bend tabs of keywashers down. Evenly loosen and remove the bolts and nuts (if equipped with the locating stud, post SB PW4ENG 73-88)

that attach the transducer. Discard the keywashers, if used. Remove the No. 1 bearing vibration transducer cable bracket from the transducer flange (if equipped).

(5)Reposition PT2.5 tube to allow removal of transducer from case.

CAUTION : DO NOT ATTEMPT TO ROTATE TRANSDUCER UNTIL DISENGAGED FROM INNER BRACKET.

Pre SB PW4ENG 73-88

(6)Use PWA101359 puller to break the interface between the flange of the transducer probe and the intermediate case.

End Pre SB PW4ENG 73-88

Post SB PW4ENG 73-88

(7)Use three jackscrews (0.190-32) in the transducer flange jackscrew holes to break the interface between the flange of the transducer probe and the intermediate case.

End SB PW4ENG 73-88

(8)Remove the transducer. Remove the three packings and discard them.

(9)Install protective closures.

C. Installation (Ref. Fig. 401)

(1)Remove protective closures.

(2)Examine and adjust, if necessary, the gap between the end of the transducer and the rotor as follows.

(a)Apply Material No.P06-015, approximately 0.070 in. (1.778 mm) thick to flat surface on small end of transducer probe.

(b)Install Class 1 shim in machined recess on lower shoulder of transducer probe.

NOTE : Do not install the three packings on the transducer at this time.

CAUTION : INSTALL TRANSDUCER WITH LARGER ELECTRICAL CONNECTOR REARWARD. DO NOT ROTATE TRANSDUCER DURING INSTALLATION OR DAMAGE TO TRANSDUCER OR ENGINE MAY RESULT.

(c)Carefully install spring - loaded speed transducer probe into opening in intermediate case at approximately 5 o'clock position with electrical connector rearward.

(d)Lubricate the bolts and nuts (if equipped with the locating stud, post SB PW4ENG 73-88) with Material No.P03-001. Temporarily install the washers, bolts and nuts (if equipped). Tighten evenly and engage the transducer to the case completely. TORQUE the bolts and nuts (if equipped) to 85 lbf.in. (0.97 m.daN). Make certain you engage the transducer to the case completely.

(e)Slowly rotate fan rotor approximately 15 degrees counterclockwise as viewed from engine.

(f)Loosen bolts and remove transducer probe from engine.

(g)Carefully cut a section of wax away from end of transducer and mesure thickness of wax remaining in area of deepest impression. If result is between 0.020 and 0.050 in. (0.508 and 1.270 mm), proper shim is installed.

(h)If result is smaller than 0.020 in. (0.508 mm), replace class 1 shim with a Class 2 shim.

(i)If result is greater than 0.050 in. (1.270 mm), remove Class 1 shim.

(j)Remove all wax from end of transducer probe.

(3)Install two new packings, lubricated with Material No.P03-001, to the grooves in the shaft of the transducer. Install one new packing, lubricated with Material No.P06-002, to the groove in the transducer flange. Make certain that the correct shim (if required) is installed on the transducer.

CAUTION : INSTALL TRANSDUCER WITH LARGER ELECTRICAL CONNECTOR REARWARD. DO NOT ROTATE TRANSDUCER DURING INSTALLATION OR DAMAGE TO TRANSDUCER OR ENGINE MAY RESULT.

(4)Carefully reinstall transducer probe in intermediate case with electrical connector rearward.

(5)For engines with the No. 1 bearing vibration transducer cable bracket, install the bracket to the forward two holes. Attach the transducer as follows (Ref. Fig. 401) (Sheet 2).

CAUTION : YOU MUST USE KEYWASHERS WITH CASES THAT DO NOT HAVE SELF-LOCKING INSERTS IN THE INTERMEDIATE CASE BOSS.

(a)Lubricate the bolts with Material No.P03-001

(b)Install the bolts and washers (keywashers for engines without self-locking inserts) that attach the transducer. Tighten evenly by hand.

NOTE : Use the longer bolts at the bracket location if equipped.

(c)For engines with the locating stud, install the keywasher and nut, lubricated with Material No.P03-001. Tighten by hand.

(d)TORQUE (as equipped)

- the bolts without the self-locking insert feature to between 65 and 85 lbf.in. (0.74 and 0.96 m.daN)
- the bolts with the self-locking insert feature to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN)
- the nut on the locating stud to between 150 and 170 (1.69 and 1.92 m.daN).

(e)Bend the keywasher tabs if used.

(6)If equipped, install the clamp and bolt, lubricated with Material No.P03-001, and attach the No. 1 bearing vibration transducer cable to the bracket. TORQUE the clamp bolt to between 36 and 40 lbf.in. (0.41 and 0.45 m.daN).

CAUTION : DO NOT USE LUBRICANTS ON PMUX SENSING TUBES, ADAPTERS, OR PACKINGS. CONTAMINATION OF PMUX CAN RESULT.

(7)Connect PT2.5 tube to transducer handtight only.

(8)Install clamp and bolt, threads lubricated with Material No.P03-001, securing tube to Flange E bracket at approximately 5 o'clock position. TORQUE bolt to between 36 and 40 lbf.in. (0.40 and 0.45 m.daN).

(9)TORQUE PT2.5 tube nut to between 135 and 150 lbf.in. (1.53 and 1.69 m. daN) and wirelock.

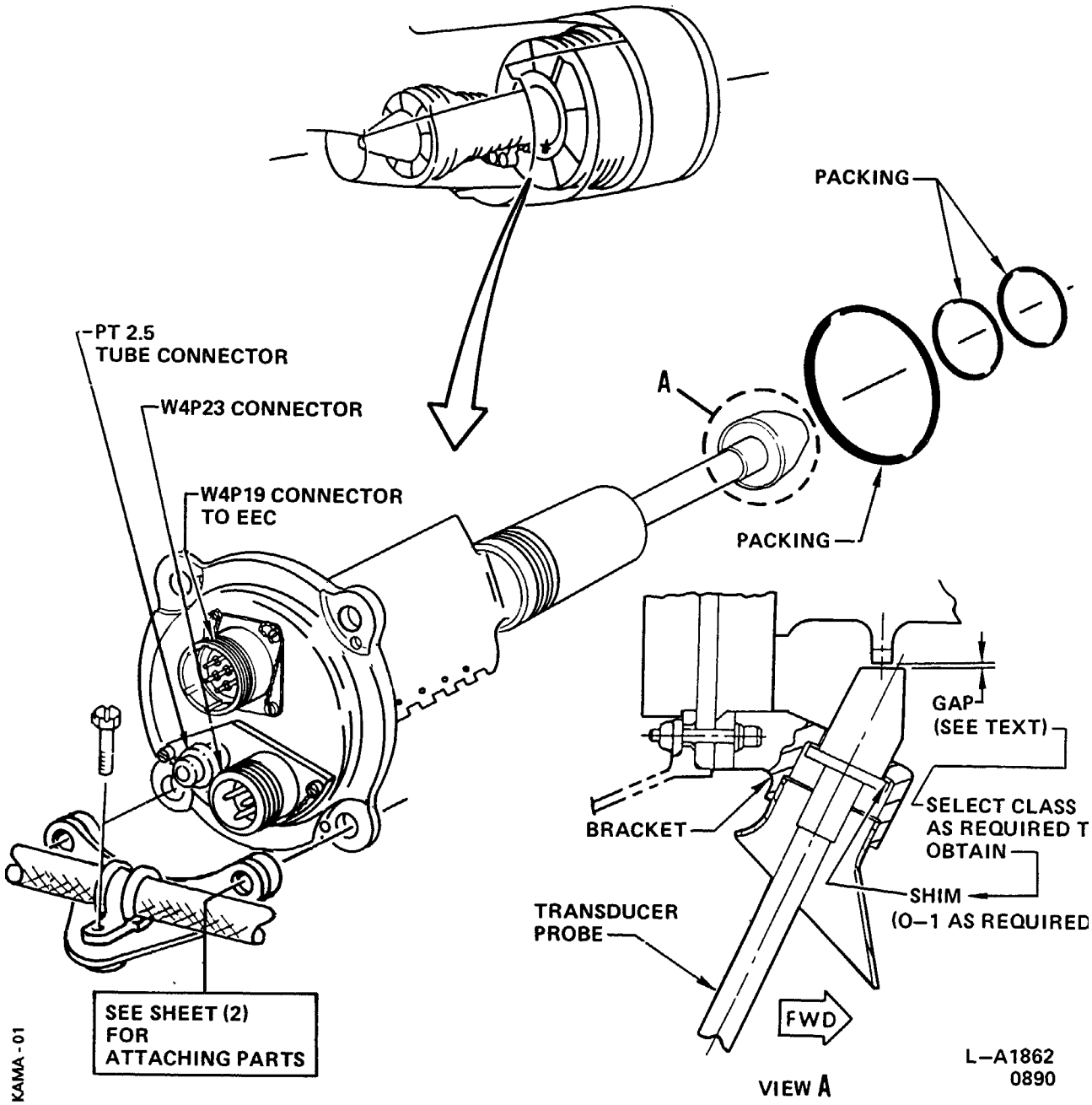
CAUTION : USE THE CORRECT ASSEMBLY PROCEDURE AND TOOLS FOR THE HARNESS CONNECTOR INSTALLATION (REF. 70-00-00, P. BLOCK 201). IF YOU USE THE INCORRECT ASSEMBLY PROCEDURE OR TOOLS, A DAMAGED OR LOOSE CONNECTOR CAN OCCUR. A LOOSE CONNECTOR PERMITS VIBRATION, WHICH CAN CAUSE THE CONTACTS TO WEAR AND UNSATISFACTORY LIGHTNING PROTECTION.

(10)Connect W4P19 harness connector to transducer probe (Ref. 70-00-00, P. Block 201).

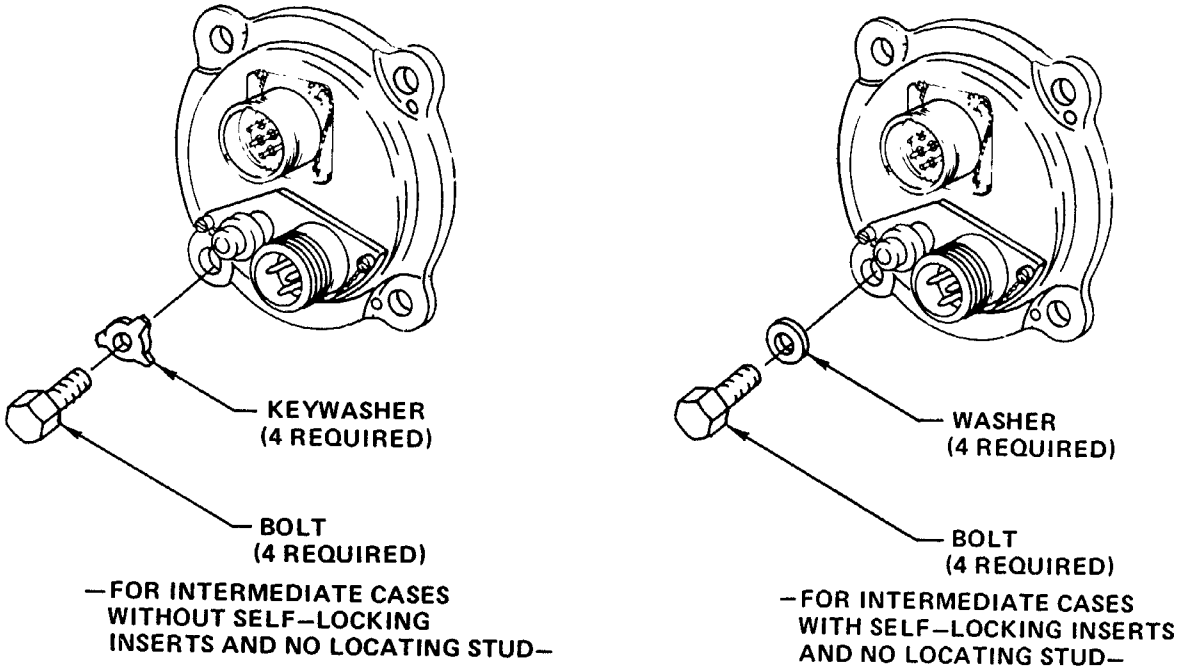
(11)Connect W4P23 harness connector to remaining connector on transducer probe (Ref. 70-00-00, P. Block 201).

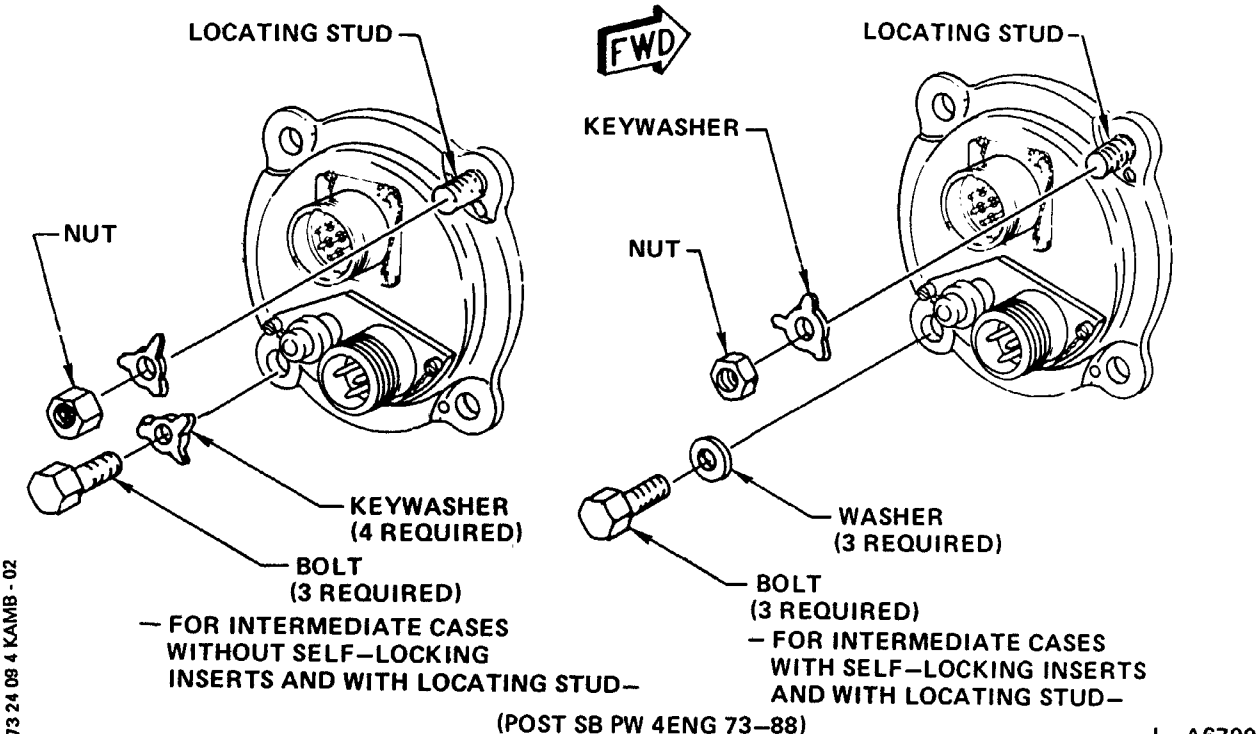
D. Close-Up and Test

(1)Install the fan exit liner segment (inner rear) that you removed (Ref. 72-23-05, P. Block 401).
(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(3)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(4)Remove safety clips and tags and close circuit breakers : 35KS, 37KS, 34KS, 36KS.
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).



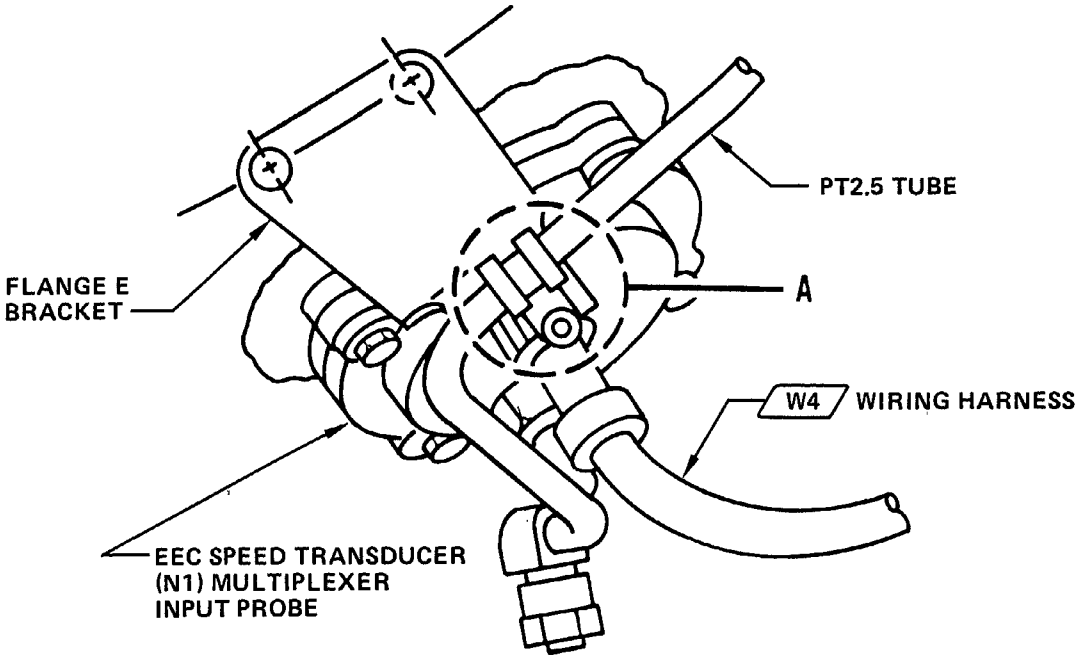
FADEC Speed Transducer (N1) (Sheet 1/3)
Figure 401

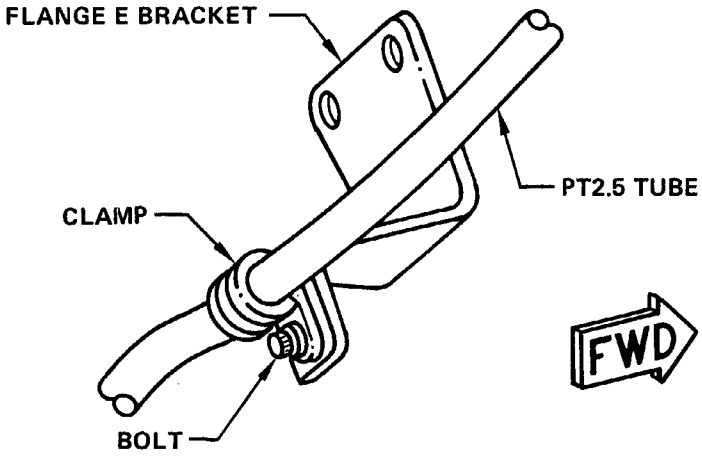




BMS 73 24 09 4 KAMB - 02

FADEC Speed Transducer (N1) (Sheet 2/3)
Figure 401





VIEW A

BM5 73 24 09 4 KAMD - 00

FADEC Speed Transducer (N1) (Sheet 3/3)
Figure 401

FADEC FUNCTIONAL INTERFACES - DESCRIPTION AND OPERATION

1. FADEC System Interface with Engine and Nacelle

A. System Configuration
The FADEC unit interfaces with engine control system by combination of electronic, hydraulic and pneumatic components. These principal components are as follows :

(1)Electronic subsystem
The electronic subsystem of the engine control system is illustrated (Ref. Fig. 001). Valve and actuator mounted torque motors, solenoids, position feedback sensors, position switches, etc. are included here as part of the electronic subsystem. A listing of the components contained in the electronic subsystem along with their mounting location and a brief description is presented in Table 001.

(2)Hydraulic subsystem
The hydraulic subsystem of the engine control system is illustrated (Ref. Fig. 003). A listing of the components contained in the hydraulic subsystem along with their mounting location and a brief description is presented in Table 002.

(3)Pneumatic subsystem
The pneumatic subsystem of the engine control system is illustrated (Ref. Fig. 004). A listing of the components contained in the pneumatic subsystem along with their mounting location and a brief description is presented in Table 003.

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

R Post SB 73-2029 For A/C 101-105,

A. System Configuration
The FADEC unit interfaces with engine control system by combination of electronic, hydraulic and pneumatic components. These principal components are as follows :

(1)Electronic subsystem
The electronic subsystem of the engine control system is illustrated (Ref. Fig. 002). Valve and actuator mounted torque motors, solenoids, position feedback sensors, position switches, etc. are included here as part of the electronic subsystem. A listing of the components contained in the electronic subsystem along with their mounting location and a brief description is presented in Table 001.

(2)Hydraulic subsystem
The hydraulic subsystem of the engine control system is illustrated (Ref. Fig. 003). A listing of the components contained in the hydraulic subsystem along with their mounting location and a brief description is presented in Table 002.

(3)Pneumatic subsystem
The pneumatic subsystem of the engine control system is illustrated (Ref. Fig. 005). A listing of the components contained in the pneumatic subsystem along with their mounting location and a brief description is presented in Table 003.

**ON A/C 101-200,

COMPONENT	MOUNTING LOCATION	DESCRIPTION
FADEC	Fan Case	Integral Vibration Isolators, Natural Convection Cooled
Permanent Magnet Alternator	Accessory Gearbox	Dual Independent Power Windings, Independent Cockpit N2 Winding
Stator Vane Actuator Torque Motor	Integral With Stator Vane Actuator	Dual Independent Windings
Stator Vane Actuator Position Sensor	Integral with Stator Vane Actuator	Dual Independent LVDT's with Dual Thermal Compensation Windings
Turbine Case Cooling Actuator Torque Motor	Integral with TCC Actuator	Dual Independent Windings
Turbine Case Cooling Actuator Position Sensor	Integral with TCC Actuator	Dual Independent LVDT's
Intercompressor (2.5) Bleed Actuator Torque Motor	Integral with 2.5 Bleed Actuator	Dual Independent Windings
Intercompressor (2.5) Bleed Position Sensor	Integral with 2.5 Bleed Actuator Assembly	Dual Independent Winding RVT's
IDG Air/Oil Heat Exchanger Solenoid	Integral with IDG Air/Oil Heat Exchanger Valve Assy	Dual Independent Solenoid Windings
Engine Air/Oil Heat Exchanger Solenoid	Integral with Engine Air/Oil Heat Exchanger Valve Assy	Dual Independent Windings
Engine Air/Oil Heat Exchanger Position Sensor	Integral with Engine Air/Oil Heat Exchanger Valve Assy	Dual Independent Winding RVT's
Thermatic Rotor Control Solenoid A	Part of No.1 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls One Valve
Thermatic Rotor Control Solenoid B	Part of No.2 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls One Valve
Turbine (Blade and Vane) Cooling Air Solenoid	Part of No.1 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls Two Valves
Compressor Stability 2.9 Bleed Valve Thermocouple probe No. 1	Part of No.3 Four Way Compressor Start/ Stability Bleed Valve No. 1	Dual Independent Solenoid Probe

COMPONENT	MOUNTING LOCATION	DESCRIPTION
2.9 Bleed Valve Thermocouple probe No. 2	Compressor Start/ Stability Bleed Valve No. 2	Probe
Bleed No.1 Compressor Stability	Solenoid Valve Assembly Part of No.3 Four Way	Windings Dual Independent Solenoid
Bleed No.2	Solenoid Valve Assembly	Windings
Fuel Metering Valve Torque Motor	Integral With Fuel Metering Unit	Dual Independent Windings
Fuel Metering Valve Position Sensor	Integral With Fuel Metering Unit	Dual Independent Winding Resolver
Overspeed Solenoid	Integral with Fuel Metering Unit	Dual Independent Solenoid Windings
Fuel/Oil Cooler Bypass Solenoid	Integral With Oil Bypass On Fuel/Oil Cooler	Dual Independent Solenoid Windings
Low Rotor Speed (N1) Sensor	Intermediate Case Sensing Teeth On Low Rotor Shaft	Dual Independent Magnetic Pick-Ups In A Single Housing
High Rotor Speed (N2) Sensor	Integral With Permanent Magnet Alternator	FADEC Uses Power Winding Frequency, Independent Cockpit N2 Winding
Ambient Pressure (PAMB) Sensor	Mounted In Nose Cowl	Single Vibrating Cylinder Transducer
Inlet Pressure (P2) Sensor	Mounted In Nose Cowl	Single Vibrating Cylinder Transducer
Burner Pressure (PB) Sensor	Mounted In Diffuser Case	Single Vibrating Cylinder Transducer
Exhaust Pressure (P5) Sensor	Mounted In Exhaust Case	Single Vibrating Cylinder Transducer
Fuel Temperature Sensor	Fuel Pump Interstage Passage	Dual Independent Chromel/ Alumel Thermocouples In A Single Housing
Engine Oil Temperature Sensor	Gearbox Oil Scavenge Line	Dual Independent Chromel/ Alumel Thermocouples In A Single Housing
Inlet Temperature (T2) Sensor	P2/T2 Probe On Engine Nacelle	Dual Independent Platinum Resistance Elements In A Single Housing
Compressor Discharge Temperature (T3) Sensor	Diffuser Case	Dual Independent Chromel/ Alumel Thermocouples
Exhaust Gas Temperature (T5) Sensor	Multiple Sensor Elements Mounted In 4 P5/T5 Probes	3 Cr/Al Thermocouples In Each Of 4 Probes Connected In Parallel
Fuel Pump Diverter Valve Position Switch	Integral With Diverter Valve On Fuel Pump	...
Engine Wiring Harness	Engine Core And Fan Case	Interconnects All Electronic Subsystem Components
Thrust Reverser Status Sensor	Engine Nacelle Adjacent To Translating Sleeve	Dual Independent Winding RVDT's

COMPONENT	MOUNTING LOCATION	DESCRIPTION
Intercompressor Pressure (P2.5) Sensor	Mounted on Fan Case	...
Intercompressor Temperature (T2.5) Sensor	Part of P2.5/T2.5/N1 Probe Assembly	Replaces Standard N1 Probe
SCU	Fan Case	Provides Expanded Engine Diagnostic Data and Supplies FADEC
Engine Serial Number Plug	SCU	Engine Serial Number for Transmission on ARINC
Data Entry Modifier Plug (44-49 Not Used)	FADEC	Rating, Package and EPR Modification Data

Engine Control System - Electronic Subsystem Components
Table 001

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

R Post SB 73-2029 For A/C 101-105,

COMPONENT	MOUNTING LOCATION	DESCRIPTION
FADEC	Fan Case	Integral Vibration Isolators, Natural Convection Cooled
Permanent Magnet Alternator	Accessory Gearbox	Dual Independent Power Windings, Independent Cockpit N2 Winding
Stator Vane Actuator Torque Motor	Integral With Stator Vane Actuator	Dual Independent Windings
Stator Vane Actuator Position Sensor	Integral with Stator Vane Actuator	Dual Independent LVDT's with Dual Thermal Compensation Windings
Turbine Case Cooling Actuator Torque Motor	Integral with TCC Actuator	Dual Independent Windings
Turbine Case Cooling Actuator Position Sensor	Integral with TCC Actuator	Dual Independent LVDT's
Intercompressor (2.5) Bleed Actuator Torque Motor	Integral with 2.5 Bleed Actuator	Dual Independent Windings
Intercompressor (2.5) Bleed Position Sensor	Integral with 2.5 Bleed Actuator Assembly	Dual Independent Winding RVT's
IDG Air/Oil Heat Exchanger Solenoid	Integral with IDG Air/Oil Heat Exchanger Valve Assy	Dual Independent Solenoid Windings
Engine Air/Oil Heat Exchanger Solenoid	Integral with Engine Air/Oil Heat Exchanger Valve Assy	Dual Independent Windings
Engine Air/Oil Heat Exchanger Position Sensor	Integral with Engine Air/Oil Heat Exchanger Valve Assy	Dual Independent Winding RVT's
Turbine (Vane) Cooling Air Solenoid A	Part of No.1 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls One Valve
Turbine (Blade and Vane) Cooling Air Solenoid B	Part of No.2 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls One Valve
Turbine (Blade and Vane) Cooling Air Solenoid A	Part of No.1 Four Way Solenoid Valve Assy	Single Winding Solenoid, Controls Two Valves
2.9 Bleed Valve Thermocouple probe No. 1	Compressor Start/ Stability Bleed Valve No. 1	Probe

COMPONENT	MOUNTING LOCATION	DESCRIPTION
2.9 Bleed Valve Thermocouple probe No. 2	Compressor Start/ Stability Bleed Valve No. 2	Probe
Compressor Stability Bleed No.1	Part of No.3 Four Way Solenoid Valve Assembly	Dual Independent Solenoid Windings
Compressor Stability Bleed No.2	Part of No.3 Four Way Solenoid Valve Assembly	Dual Independent Solenoid Windings
Fuel Metering Valve Torque Motor	Integral With Fuel Metering Unit	Dual Independent Windings
Fuel Metering Valve Position Sensor	Integral With Fuel Metering Unit	Dual Independent Winding Resolver
Overspeed Solenoid	Integral with Fuel Metering Unit	Dual Independent Solenoid Windings
Fuel/Oil Cooler Bypass Solenoid	Integral With Oil Bypass On Fuel/Oil Cooler	Dual Independent Solenoid Windings
Low Rotor Speed (N1) Sensor	Intermediate Case Sensing Teeth On Low Rotor Shaft	Dual Independent Magnetic Pick-Ups In A Single Housing
High Rotor Speed (N2) Sensor	Integral With Permanent Magnet Alternator	FADEC Uses Power Winding Frequency, Independent Cockpit N2 Winding
Ambient Pressure (PAMB) Sensor	Mounted In Nose Cowl	Single Vibrating Cylinder Transducer
Inlet Pressure (P2) Sensor	Mounted In Nose Cowl	Single Vibrating Cylinder Transducer
Burner Pressure (PB) Sensor	Mounted In Diffuser Case	Single Vibrating Cylinder Transducer
Exhaust Pressure (P5) Sensor	Mounted In Exhaust Case	Single Vibrating Cylinder Transducer
Fuel Temperature Sensor	Fuel Pump Interstage Passage	Dual Independent Chromel/ Alumel Thermocouples In A Single Housing
Engine Oil Temperature Sensor	Gearbox Oil Scavenge Line	Dual Independent Chromel/ Alumel Thermocouples In A Single Housing
Inlet Temperature (T2) Sensor	P2/T2 Probe On Engine Nacelle	Dual Independent Platinum Resistance Elements In A Single Housing
Compressor Discharge Temperature (T3) Sensor	Diffuser Case	Dual Independent Chromel/ Alumel Thermocouples
Exhaust Gas Temperature (T5) Sensor	Multiple Sensor Elements Mounted In 4 P5/T5 Probes	3 Cr/Al Thermocouples In Each Of 4 Probes Connected In Parallel
Fuel Pump Diverter Valve Position Switch	Integral With Diverter Valve On Fuel Pump	...
Engine Wiring Harness	Engine Core And Fan Case	Interconnects All Electronic Subsystem Components
Thrust Reverser Status	Engine Nacelle Adjacent	Dual Independent Winding

COMPONENT	MOUNTING LOCATION	DESCRIPTION
Sensor	To Translating Sleeve	RVDT's
Intercompressor Pressure (P2.5) Sensor	Mounted on Fan Case	...
Intercompressor Temperature (T2.5) Sensor	Part of P2.5/T2.5/N1 Probe Assembly	Replaces Standard N1 Probe
SCU	Fan Case	Provides Expanded Engine Diagnostic Data and Supplies FADEC
Engine Serial Number Plug	SCU	Engine Serial Number for Transmission on ARINC
Data Entry Modifier Plug (44-49 Not Used)	FADEC	Rating, Package and EPR Modification Data

Engine Control System - Electronic Subsystem Components
Table 001

**ON A/C 101-200,

ITEM NUMBER	COMPONENT	MOUNTING LOCATION	DESCRIPTION
50	Fuel Pump	Accessory Gear Box	Centrifugal Boost And Gear Pressure Stage
51	Fuel/Oil Cooler	Left Side Engine Case	Fuel to Engine Oil And IDG Oil Cooler
52	Fuel Filter	Integral With Fuel Pump	Between Pump Stages And After Fuel/Oil Cooler
53	Fuel Metering Unit	Mount On Fuel Pump	Contains WF Flow Control And Pressure Regulation Functions
54	Fuel Bypass Valve	Mounts On Fuel Pump	Two Position Pressure Actuated ; Bypass Flow Diverted Around IDG Portion of FOC At N2 Speeds Above Idle
55	Fuel Flow Meter	Right Side Of Engine Before Fuel Distribution Valve	Used For Aircraft Functions Only
56	Fuel Distribution Valve	Right Side Of Engine	Functions As Check Valve And Divides Fuel Into 8 Lines
57	Fuel Injector	Diffuser Case	Introduces Fuel Into Combustor ; 24 Used
58	Air/Oil Heat Exchanger Actuator	Integral With Heat Exchanger Valve Assembly	Flapper Valve Controlled, Continuous Air Flow Modulation
59	IDG Air/Oil Heat Exchanger Actuator	Integral With IDG Heat Exchanger Valve Assembly	On/Off Operation Only
60	Intercompressor (2.5) Bleed Actuator	Intermediate Case Adjacent To 2.5 Bleed Ring	Pilot Valve Controlled, Continuous 2.5 Bleed Modulation
61	Stator Vane Actuator	Right Side Engine Case Adjacent To Vane Actuating Rings	Pilot Valve Controlled, Continuous Stator Vane Angle Modulation
62	Turbine Case Cooling Actuator	Right Side Of Engine Case	Pilot Valve Controlled, Continuous Modulation, Push-Pull Cable Connection To Air Flow Valves
63	Fuel/Oil Cooler Bypass Valve	Mounts On Fuel/Oil Cooler	Two Position Solenoid Controlled, Bypass Engine Oil Around Cooler
64	Fuel Filter ΔP Switch	Mounts on Fuel Pump	Interfaces Directly with Airframe
65	(65-69) Not Used)		

ITEM NUMBER	COMPONENT	MOUNTING LOCATION	DESCRIPTION
70	Engine Air/Oil Heat Exchanger Valve	Left Side Of Intermediate Case With AOHE	Integral Valve And Continuous Modulation Hydraulic Actuator
71	IDG Air/Oil Heat Exchanger Override Solenoid Valve	Part of No.2 Four Way Solenoid Valve Assembly	Solenoid Actuator On/Off Pneumatic Valve
72	IDG Air/Oil Heat Exchanger Override Pressure Switch	Right Side of Intermediate Case Adjacent to No.2 Four Way Solenoid Valve Assembly	Pneumatically Actuated On/Off Electrical Switch
73	IDG Air/Oil Heat Exchanger Valve	Right Side of Intermediate Case With IDG Air/Oil Heat Exchanger	Integral Valve And On/Off Hydraulic Actuator
74	Intercompressor (2.5) Bleed Valve	Intermediate Case	2.5 Bleed Ring Integral With Intermediate Case, Continuous Modulation Hydraulic Actuator
75	Turbine (Blade and Vane) Cooling Air Valve	One Left And Right Side Adjacent To 12th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Two Used
76	Turbine (Blade and Vane) Cooling Air Solenoid Control Valve	Part Of Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
77	Thermatic Rotor Control Thrust Balance Vent Valve B	Right Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To TRC Valve A
78	Thermatic Rotor Control Thrust Balance Vent Solenoid Control Valve B	Part Of IDG O/R-TRC/TBV Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
79	Thermatic Rotor Control Thrust Balance Vent Valve A	Left Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To TRC Valve B
80	Thermatic Rotor Control Thrust Balance Vent Solenoid Control Valve A	Part Of TCA-TRC/TBV Solenoid Valve Assembly Left Side Engine Case Adjacent To 9th Stage Bleed	Solenoid Actuated On/Off Pneumatic Valve
81	Compressor Start/ Stability Bleed Valve No. 1	Left Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To Compressor Stability Bleed Valve No. 2
82	Compressor Start/ Stability Bleed	Part Of Start/Stability Bleed Solenoid Valve	Solenoid Actuated On/Off Pneumatic Valve

ITEM NUMBER	COMPONENT	MOUNTING LOCATION	DESCRIPTION
	No. 1 Solenoid Control Valve	Assembly	
83	Compressor Start/ Stability Bleed Valve No. 2	Right Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To compressor Stability Bleed Valve No. 1
84	Compressor Start/ Stability Bleed No. 2 Solenoid Control Valve	Part Of Start/Stability Bleed Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
85	High Pressure Turbine Case Cooling Valve	Adjacent To Right Side Turbine Case	Integral With LP TCC Valve, Modulation Via Mechanical Linkage From LP TCC Valve
86	Low Pressure Turbine Case Cooling Valve	Adjacent To Right Side Turbine Case	Integral With HP TCC Valve, Continuous Modulation Via Push Pull Cable From Hydraulic Actuator
87	Pneumatic Relay Valve	Adjacent To Start/Stability Bleed Solenoid Valve Assembly	In Line With The Left Side Stability Bleed Pneumatic Supply

Engine Control System - Pneumatic Subsystem Components
Table 003

R **ON A/C 101-105,

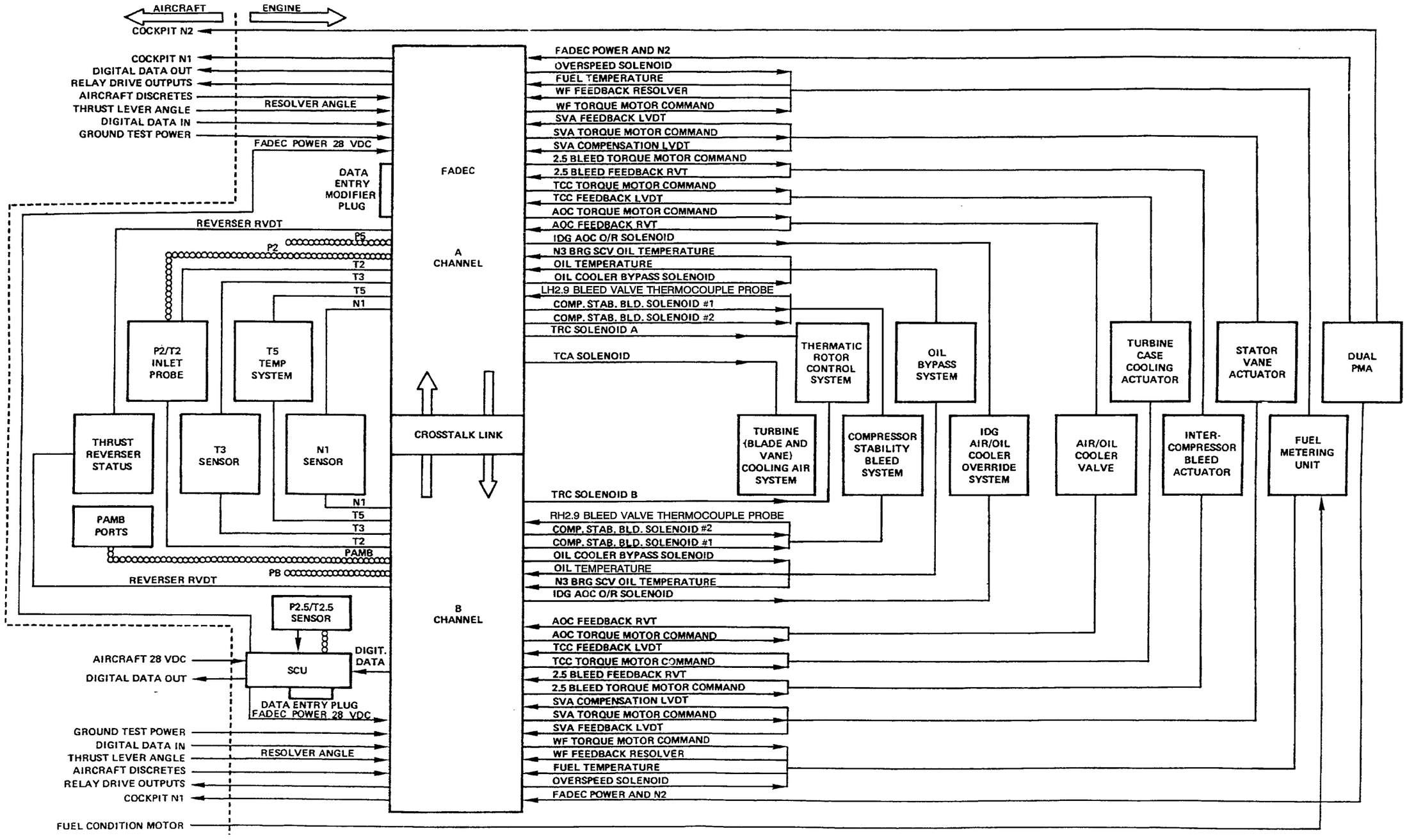
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ITEM NUMBER	COMPONENT	MOUNTING LOCATION	DESCRIPTION
70	Engine Air/Oil Heat Exchanger Valve	Left Side Of Intermediate Case With AOHE	Integral Valve And Continuous Modulation Hydraulic Actuator
71	IDG Air/Oil Heat Exchanger Override Solenoid Valve	Part of No.2 Four Way Solenoid Valve Assembly	Solenoid Actuator On/Off Pneumatic Valve
72	IDG Air/Oil Heat Exchanger Override Pressure Switch	Right Side of Intermediate Case Adjacent to No.2 Four Way Solenoid Valve Assembly	Pneumatically Actuated On/Off Electrical Switch
73	IDG Air/Oil Heat Exchanger Valve	Right Side of Intermediate Case With IDG Air/Oil Heat Exchanger	Integral Valve And On/Off Hydraulic Actuator
74	Intercompressor	Intermediate Case	2.5 Bleed Ring Integral

ITEM NUMBER	COMPONENT	MOUNTING LOCATION	DESCRIPTION
	(2.5) Bleed Valve		With Intermediate Case, Continuous Modulation Hydraulic Actuator
75	Turbine (Blade and Vane) Cooling Air Valve	One Left And Two Right Side Adjacent To 12th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Three Used
76	Turbine (Blade and Vane) Cooling Air Solenoid Control Valve	Part Of TCA Solenoid Valve Assembly. Left Side Engine Case Adjacent to 9th Stage Bleed	Solenoid Actuated On/Off Pneumatic Valve
78	Turbine (Blade and Vane) Cooling Air Solenoid Control Valve	Part Of IDG O/R-TCA Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
80	Turbine (Vane) Cooling Air Solenoid Control Valve	Part Of TCA Solenoid Valve Assembly Left Side Engine Case Adjacent To 9th Stage Bleed	Solenoid Actuated On/Off Pneumatic Valve
81	Compressor Start/ Stability Bleed Valve No. 1	Left Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To Compressor Stability Bleed Valve No. 2
82	Compressor Start/ Stability Bleed No. 1 Solenoid Control Valve	Part Of Start/Stability Bleed Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
83	Compressor Start/ Stability Bleed Valve No. 2	Right Side Engine Case Adjacent To 9th Stage Bleed	Integral Valve And On/Off Pneumatic Actuator, Identical To compressor Stability Bleed Valve No. 1
84	Compressor Start/ Stability Bleed No. 2 Solenoid Control Valve	Part Of Start/Stability Bleed Solenoid Valve Assembly	Solenoid Actuated On/Off Pneumatic Valve
85	High Pressure Turbine Case Cooling Valve	Adjacent To Right Side Turbine Case	Integral With LP TCC Valve, Modulation Via Mechanical Linkage From LP TCC Valve
86	Low Pressure Turbine Case Cooling Valve	Adjacent To Right Side Turbine Case	Integral With HP TCC Valve, Continuous Modulation Via Push Pull Cable From Hydraulic Actuator
87	Pneumatic Relay Valve	Adjacent To Start/Stability Bleed Solenoid Valve Assembly	In Line With The Left Side Stability Bleed Pneumatic Supply

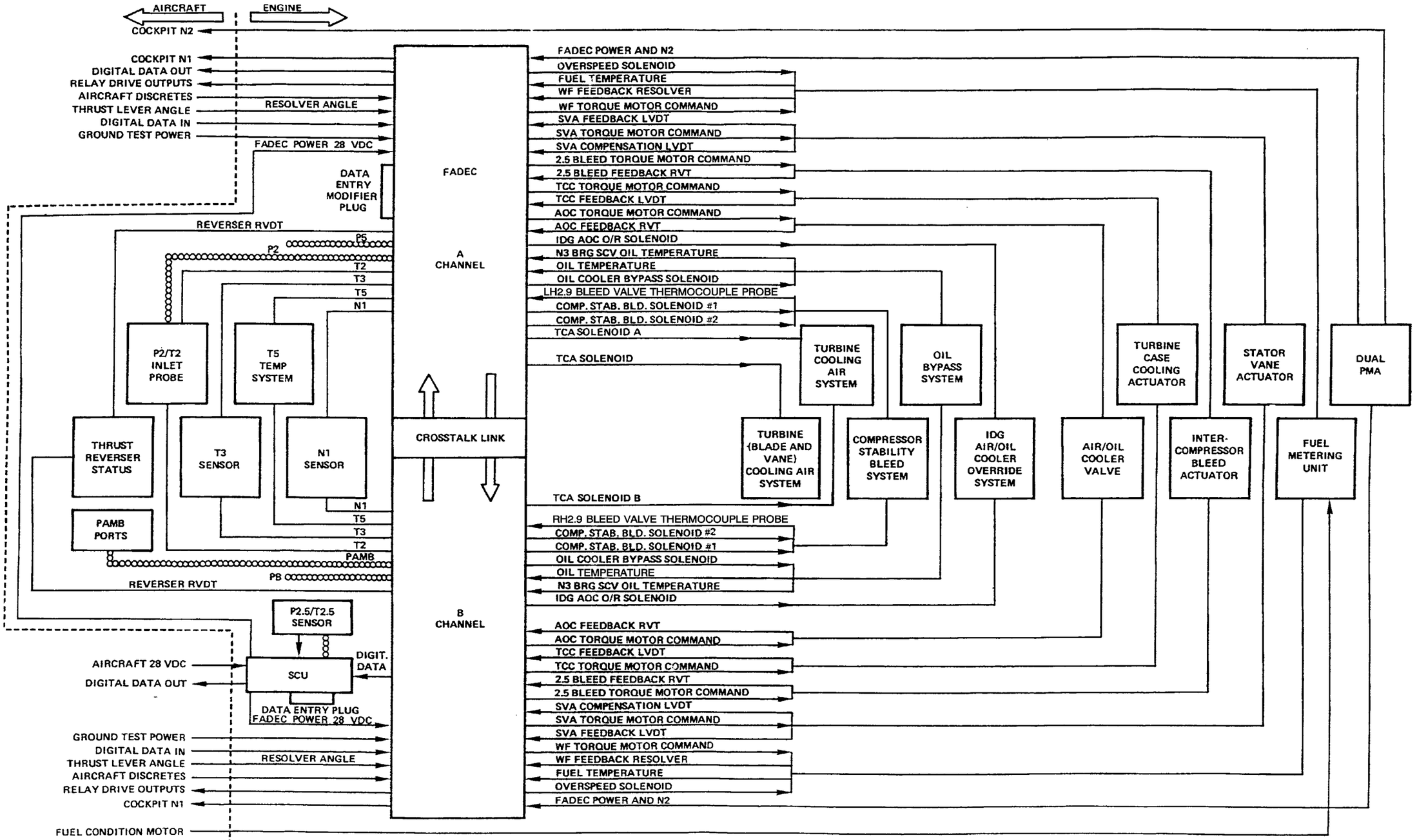
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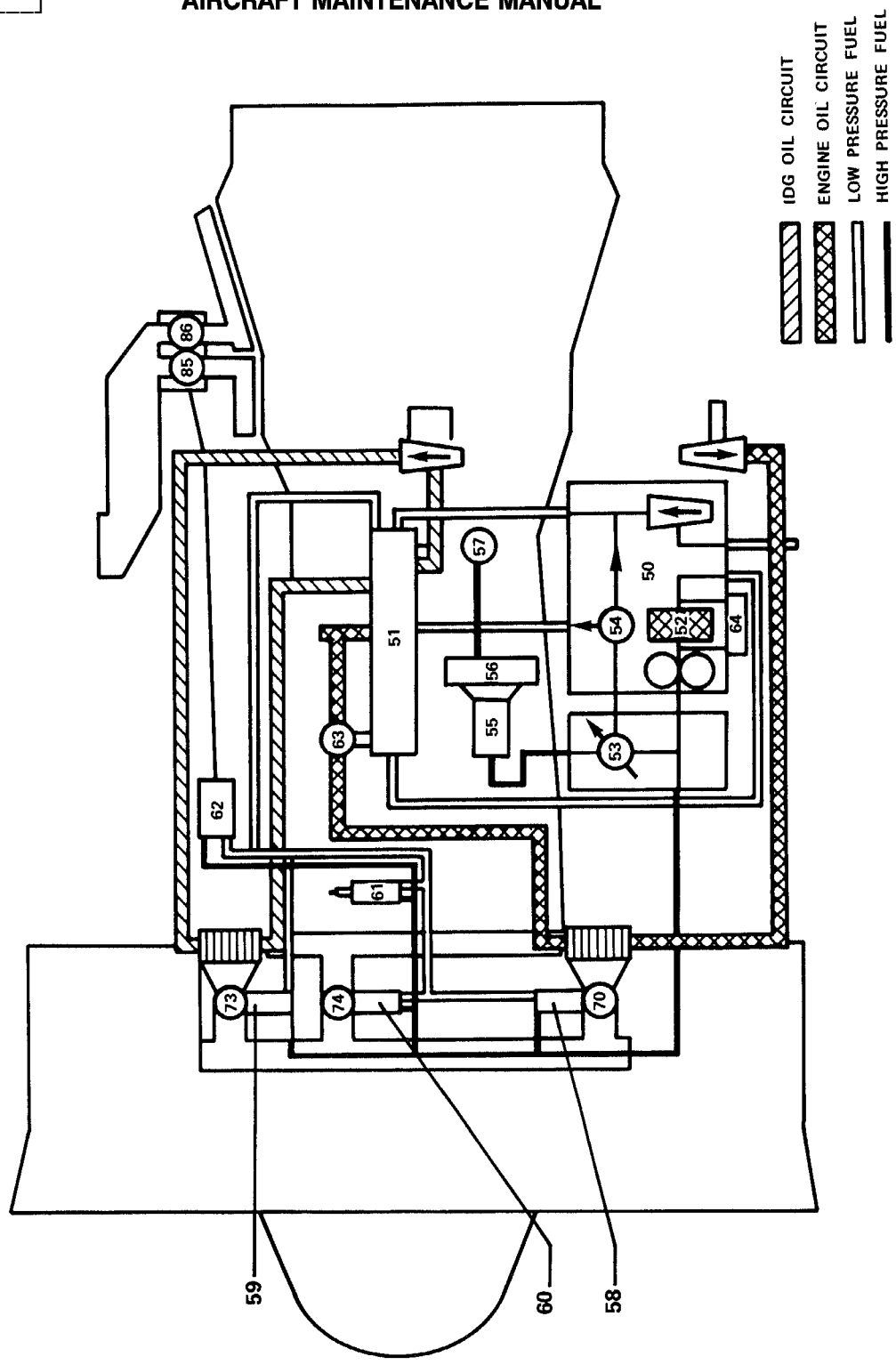
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Engine Control System Electronic Subsystem - Block Diagram
Figure 001



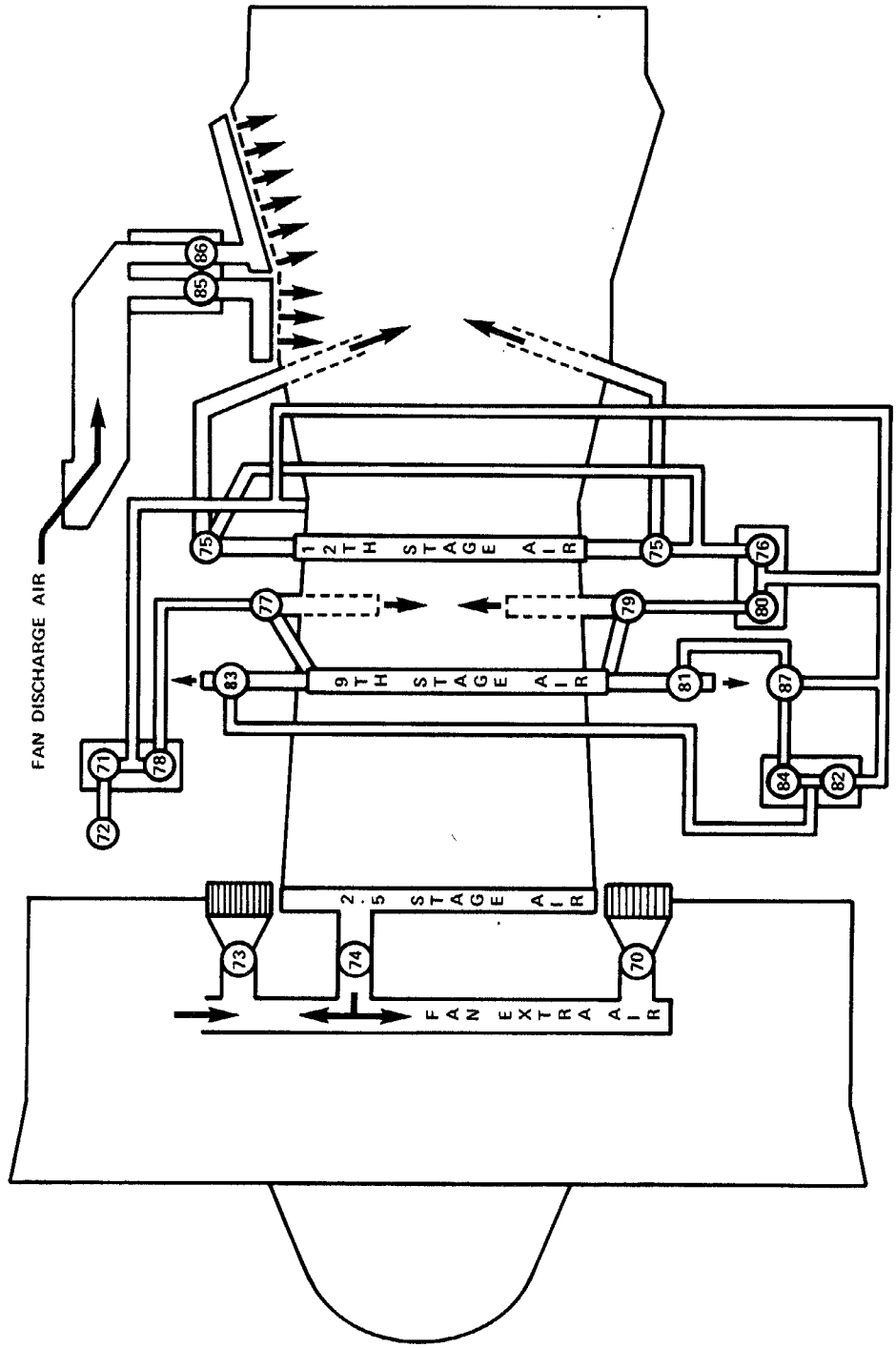
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Engine Control System Electronic Subsystem - Block Diagram
Figure 002



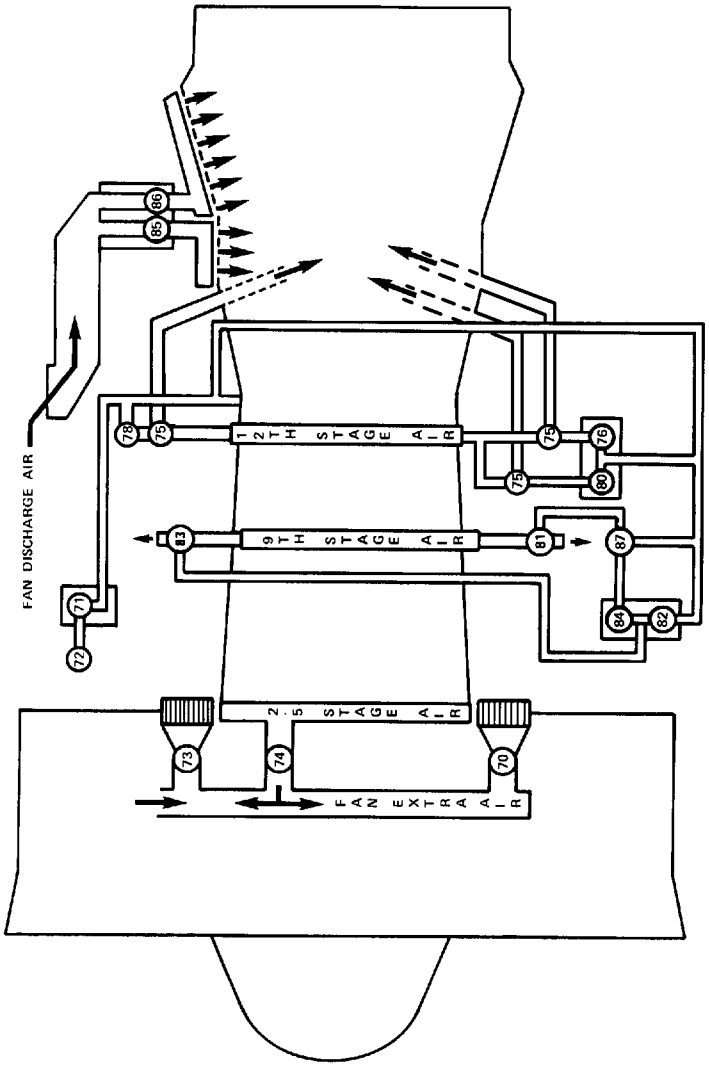
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Engine Control System Hydraulic Subsystem Block Diagram
Figure 003



BM5 73 25 00 0 KEMO - 20

Engine Control System Pneumatic Subsystem Block Diagram
Figure 004



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Engine Control System Pneumatic Subsystem - Block Diagram
Figure 005

**ON A/C 101-200,

B. Functions

(1)Fuel delivery management (Ref. Fig. 006)

The primary function of the engine control system is to schedule the delivery of fuel to the engine for combustion. Fuel delivery to the engine is controlled by a hydromechanical Fuel Metering Unit. The FMU responds to commands received from the FADEC.

The principal input used by the FADEC in scheduling fuel flow is TLA. The control algorithms employed treat TLA as a command for a specified power setting. The FADEC modulates the flow to achieve the EPR corresponding to the commanded power setting. The control algorithms used in scheduling fuel also consider acceleration and deceleration response, transient and steady state stability requirements and engine protection.

The FMU incorporates a limited level of fuel delivery management capability. This includes the fuel shut off function, regulation of critical pressure differentials, engine fuel flow windmill bypass, a maximum fuel flow stop and a minimum fuel flow stop.

(2)Stator vane management (Ref. Fig. 007, 008)

Variable geometry stator vanes are incorporated on the inlet guide vanes and the 5th, 6th and 7th stages (high pressure compressor). Stator vane actuator position is scheduled as a function of low rotor speed (N1), high rotor speed (N2) and engine inlet total temperature (T2). The FADEC interfaces with the stator vane actuator through a pilot valve positioned by a redundant coil torque motor. Stator vane actuator position is sensed by dual, temperature compensated, linear variable differential transformers (LVDT) and fed back to the FADEC.

The pilot valve, torque motor and LVDT's are integral with the stator vane actuator. The actuator is powered by hydraulic pressure supplied by the fuel pump. The relative scheduling of the four stator vane stages is controlled by a fixed geometry linkage driven by the stator vane actuator. In the event of power loss, the torque motor will cause the pilot valve to direct the stator vane actuator to the fully open position.

(3)Turbine case cooling management (Ref. Fig. 009)

The exterior surfaces of the high and low pressure turbine cases are cooled with engine fan discharge air to control turbine tip clearance. The turbine case cooling actuator position is scheduled as a function of altitude and high rotor speed (N2). The FADEC interfaces with the turbine case cooling actuator through a pilot valve positioned by a redundant coil torque motor. Turbine case cooling actuator position is sensed by dual linear variable differential transformers (LVDT) and fed back to the FADEC.

The pilot valve, torque motors and LVDT's are integral with the turbine case cooling actuator. The actuator is powered by hydraulic pressure supplied by the fuel pump. The actuator interfaces with the high and low pressure turbine case cooling air valves via a push-pull cable. The high and low pressure turbine case cooling air valves are integrated into a single assembly. Their relative schedules are controlled by a fixed geometry mechanical linkage. In the event of loss of electrical power or hydraulic pressure, the system is designed to close the cooling air valves.

(4)Compressor bleed management (Ref. Fig. 010, 011)

Bleed ports are provided between the low and high pressure compressors (Station 2.5) and after the 9th stage of the high pressure compressor to assist in maintaining overall compressor section stability during transients and steady state operation. The bleeds are scheduled as a function of TLA, low rotor speed (N1), high rotor speed (N2), Mach number, engine inlet total temperature (T2) and altitude.
The FADEC interfaces with the intercompressor (2.5) bleed actuator through a pilot valve positioned by a redundant coil torque motor. Intercompressor (2.5) bleed actuator position is sensed by dual rotational variable transformers (RVT) and fed back to the FADEC. The pilot valve, torque motor and RVT's are integral with the intercompressor (2.5) bleed actuator assembly. The actuator is powered by hydraulic pressure supplied by the fuel pump. In the event of a loss of power, the actuator is designed to move the intercompressor bleed ring to the fully open position.
The two 9th stage compressor stability bleed valves can be operated in conjunction with the intercompressor (2.5) bleed. Their operation is controlled by a fixed schedule appropriate to ensure adequate stability margins. The FADEC interfaces with the compressor stability bleed valves through two remotely mounted redundant coil solenoid valve assemblies. The compressor stability bleed valves position is sensed by two thermocouple probes and fed back to the FADEC for maintenance data.
The actuators are powered by compressor discharge pressure. In the event of loss of electrical power, compressor stability bleed valve No.2 is designed to open and compressor stability bleed valve No.1 is designed to close. In the event of loss of pneumatic pressure, both valves are designed to open.

(5)Oil and fuel temperature management

(a)General (Ref. Fig. 012)

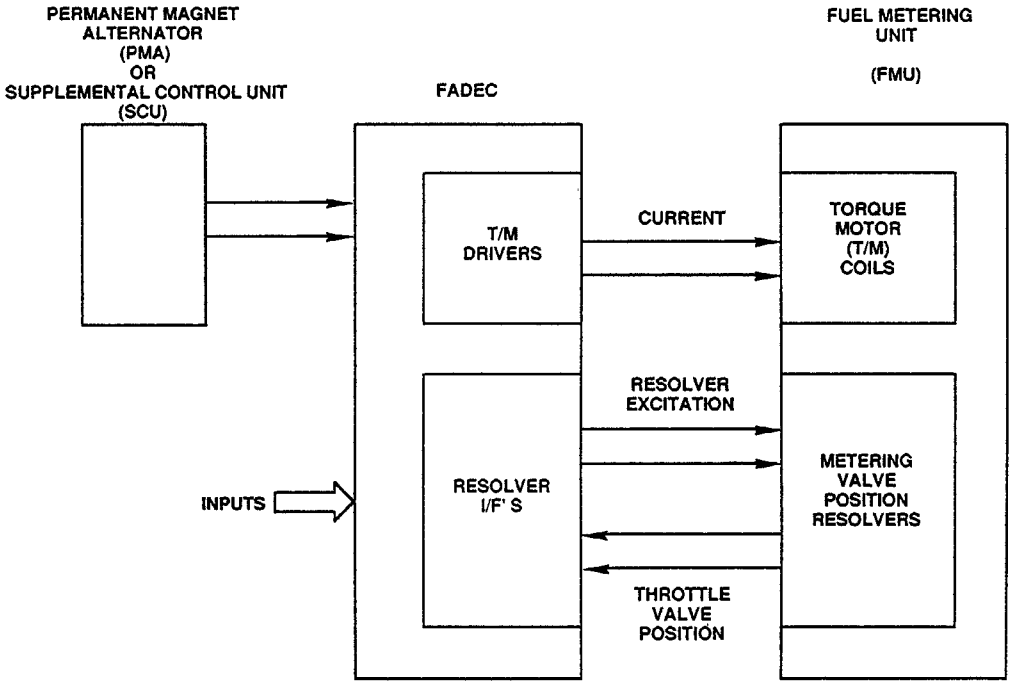
The oil and fuel temperature management function addresses the regulation of fuel temperature, engine lubricating oil temperature and Integrated Drive Generator (IDG) cooling oil temperature. Under the various engine operating modes heat is rejected to the fuel via fuel/oil cooler or to engine fan discharge air via air/oil heat exchangers. The FADEC schedules the various air, fuel and oil flow control valves as a function of fuel temperature, fuel flow rate, engine oil temperature and high rotor speed (N2).
For each of the three systems, the design goals are :

1 Fuel System - To provide acceptable fuel operating temperatures throughout the flight envelope, and provide automatic fuel deicing during potential fuel icing conditions, and automatic fuel cooling during windmilling for altitude engine relight capability.

2 Lubrication System - To provide engine oil cooling at all flight conditions to maintain "MOT" - main oil temperature out of the engine - below 325°F steady state and 350°F for transient operation (20 minutes maximum).

3 IDG System - To provide IDGS oil cooling at all flight conditions to maintain IDG oil in temperature below 260°F steady state and 285°F transient operation (2 hours maximum), as well as 90% operation below 220°F.

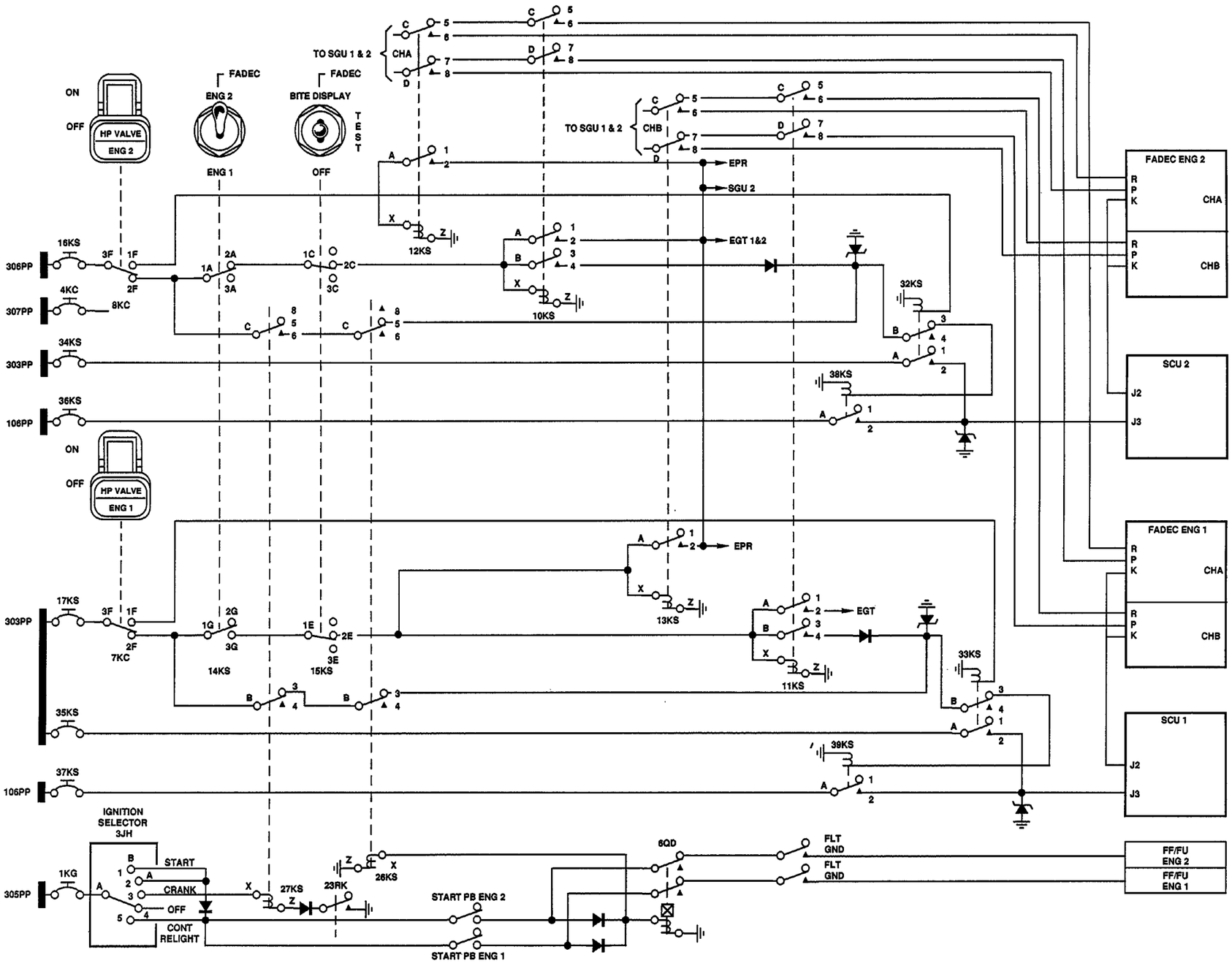
(b)Overwiew :



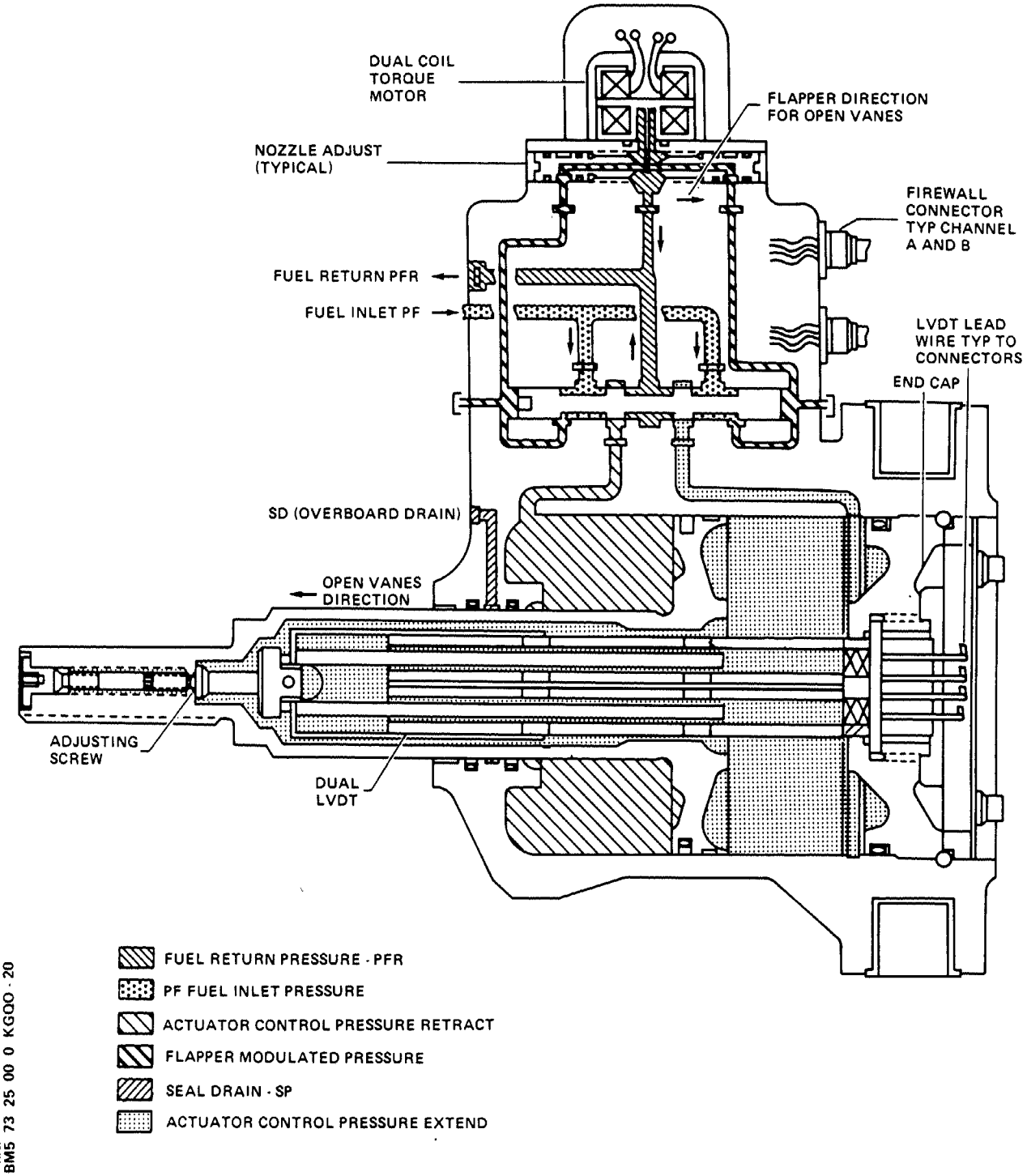
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Fuel Flow Control
Figure 006

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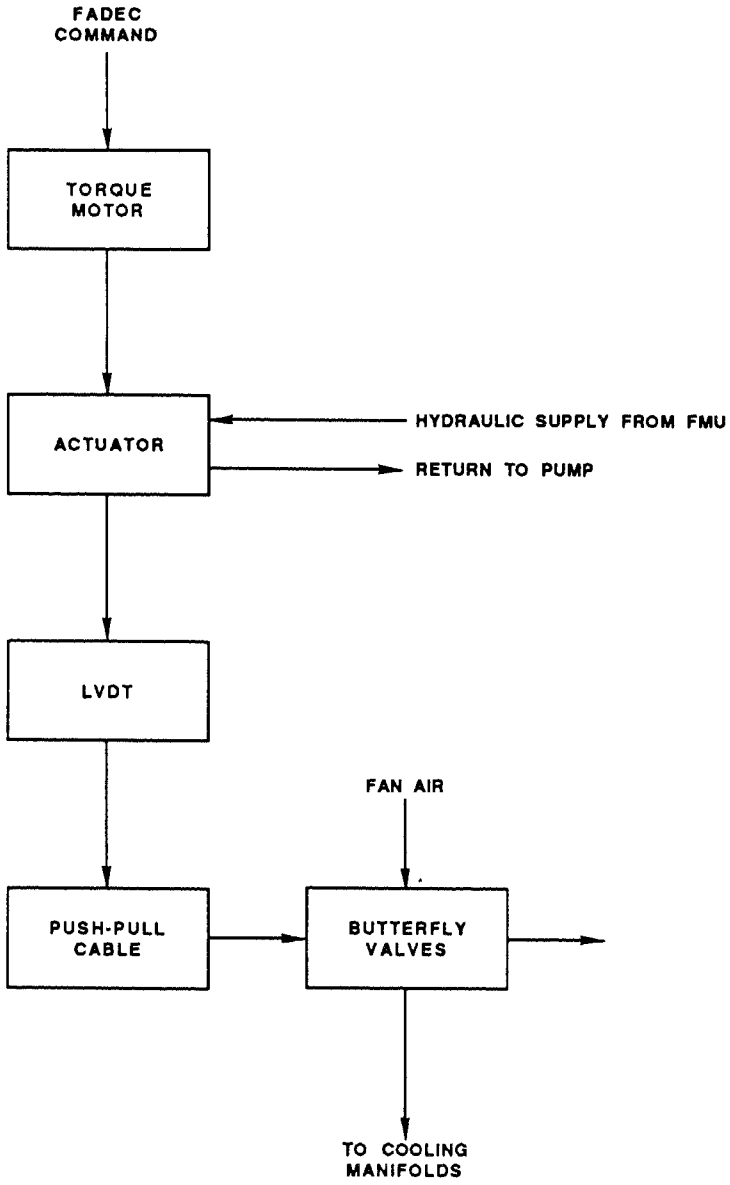


Stator Vane Actuator Functional Block Diagram
Figure 007



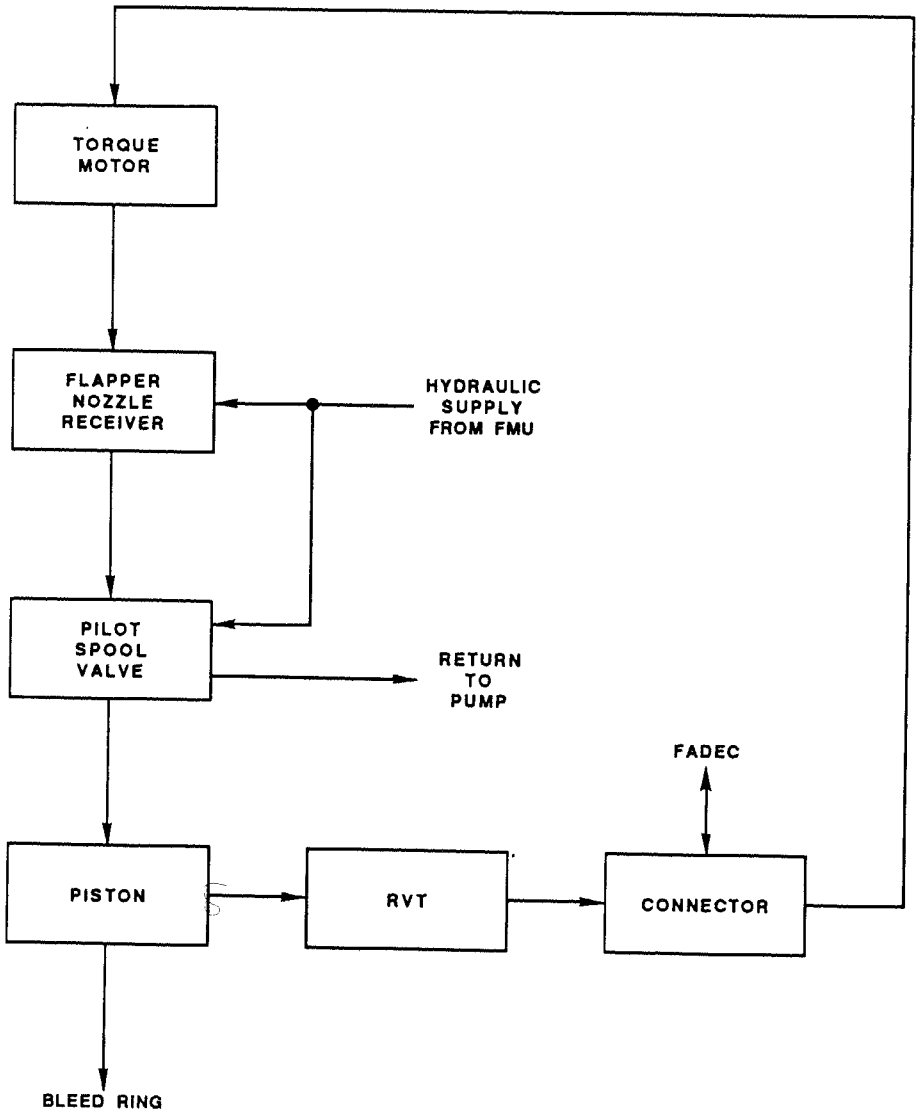
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Stator Vane Actuator
Figure 008



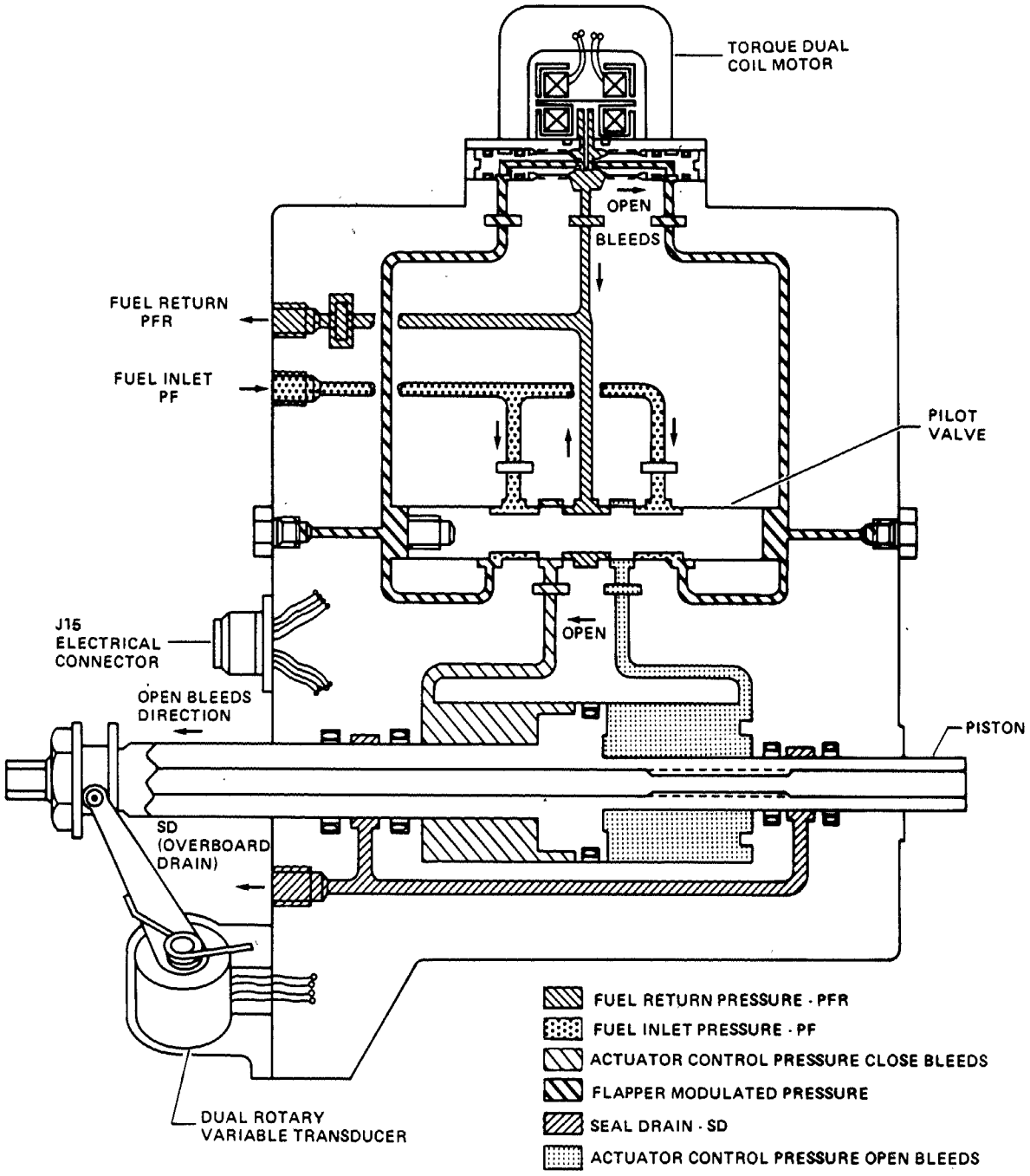
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Turbine Clearance Control System Functional Block Diagram
Figure 009



BM5 73 25 00 0 KGSO - 20

Station 2.5 Compressor Bleed Actuator Functional Block Diagram
Figure 010



BM5 73 25 00 0 KGTO - 20

Modulated 2.5 Compressor Bleed Actuator
Figure 011

- Fuel System
  Ice formation in the fuel system is prevented by heating the fuel before it passes through the fuel filter and FMU. The heat absorbed aids in cooling the engine lubricating and IDG oil supplies. When fuel temperature exceeds 127°C (260°F), the engine oil flow to the fuel/oil cooler is bypassed. Above minimum cruise speed, a fuel pump mounted diverter valve, controlled by boost stage pressure differential, causes bypass return flow from the FMU to bypass the IDG portion of the fuel/oil cooler.
  When the IDG is connected the engine fuel/oil cooler provides de-icing protection throughout the engine operating envelope with fuel temperatures down to -40 deg.F at power settings up to and including take-off and fuel temperatures down to -50 deg.F for maximum continuous power. With the IDG mechanically disconnected, engine operation at take-off power setting is permitted at temperatures down to -30 deg.F, and power settings up to and including maximum continuous at fuel temperatures down to -40 deg.F.

  1 Lubrication System
    The engine lubricating oil circuit employs an air/oil heat exchanger in series with the fuel/oil cooler. The air/oil heat exchanger receives modulated engine fan exit air via an air flow control valve when fuel temperature exceeds 121°C (250°F). The FADEC interfaces with the air/oil heat exchanger actuator through a redundant coil torque motor driven flapper valve. Air/oil heat exchanger valve position is sensed by dual rotational variable transformers (RVT) and fed back to the FADEC. The torque motor, RVT's and actuator are integral with the air/oil heat exchanger valve assembly. The actuator is powered by hydraulic pressure supplied by the fuel pump. In the event of power loss or pressure loss, the valve will move to the fully open position.

  2 IDG System
    An air/oil heat exchanger is provided for the IDG oil supply. The heat exchanger receives engine fan exit air via an on/off airflow control valve. The primary control for this valve is the GCU. It schedules valve operation as a function of IDG oil temperature and high rotor speed (N2). The engine control system is capable of overriding the GCU and opening the IDG air/oil heat exchanger valve. The override is based on engine oil temperature and high rotor speed (N2). The IDG air/oil heat exchanger incorporates a solenoid controlled actuator which is powered by hydraulic pressure supplied by the fuel pump. The solenoid and actuator are integral with the valve assembly. In the event of a loss of power or loss of fuel pressure, the valve will move to the fully open position.

(c)Components :
  The various components (heat exchangers, pumps, valves, etc.) have been arranged to accomplish the fluid temperature management (Ref. Fig. 012). Key features of the fuel/oil system include :

  1 A fuel pump interstage fuel/oil cooler for both the IDG and engine oil systems which heats the fuel upstream of the filter and fuel metering unit to prevent fuel system icing.

  2 A variable fuel bypass return which allows the IDG oil system to transfer heat to relatively cold boost stage exit fuel before mixing

with the warmer bypass fuel at power settings above min. cruise, then shifting all the bypass fuel forward and through the IDG fuel/oil cooler (as well as the engine fuel/oil cooler) at idle conditions (Ref. Fig. 013).

3 A modulated engine air/oil heat exchanger inlet air valve which is controlled by the FADEC to remain closed at fuel temperatures below 245°F, and modulated to hold a constant 246°F fuel temperature when required, and full open above 246°F fuel for maximum cooling (Ref. Fig. 014, 015).

4 A full fuel/oil cooler oil bypass valve which is controlled by the FADEC to bypass oil around the fuel/oil cooler if the fuel temperature exceeds 260°F, or during a windmill condition.

5 IDGs air/oil heat exchanger override capability to allow the inlet air valve to open at all idle conditions to cool IDG oil or when engine main oil temperature exceeds 320°F.

6 Both the engine and the IDGS air/oil heat exchangers have dual air sources - 2.5 bleed air or fan exit air - connected through a common manifold. During idle operation, when the 2.5 bleed valve is open, the air/oil heat exchangers benefit from the higher pressure air sources. During high power operation, the 2.5 bleed valve is closed and the lower temperature fan exit air is used for air/oil cooling.

(d)Control (Ref. Fig. 016)

Control of the various valves within the system is accomplished through the FADEC. Decisions are primarily based upon 4 measured input parameters :

- "T fuel" - Fuel temperature into the main pump,
- "MOT" - Main oil temperature out of the engine,
- "N2" - High rotor speed, and
- "W fuel" - Engine fuel flow.

Each of the parameters are available to each channel of the dual channel FADEC. In addition, if loss of control of any of the valves in the system is detected, the system will revert to failsafe configuration and the accommodation indicated in FADEC output buses.

The failsafe positions are defined as :

- Engine air/oil heat exchanger valve - open full
- Fuel/oil cooler bypass valve - closed
- IDG air/oil heat exchanger valve - open.

NOTE : The fuel bypass valve is independent of FADEC control and responds only to boost stage pressure rise in the fuel system. The failsafe position is to bypass fuel through both IDG and engine fuel/oil coolers.

(e)Typical operation

The following figures attempt to illustrate the dynamic quality of the engine fuel/oil system as it reconfigures, through operation of the various valves, in response to the engine operating conditions as sensed by the FADEC.

(Ref. Fig. 017) shows the schematic of the fuel/oil system during most high power (climb, take-off, etc.) conditions. All engine and IDGs heat generation is removed from the oil systems by the engine fuel. No airflow is taken from the engine and all the heat energy returns to the engine cycle via the fuel system for maximum efficiency.

(Ref. Fig. 018) describes typical cruise operation. As the engine fuel flow is reduced, a point may be reached where engine and IDG cooling requirements exceed the capacity of the fuel system to absorb the heat energy. Once the fuel temperature exceeds 245°F, the engine air/oil heat exchanger valve starts to open to hold a 246°F fuel temperature. However, the IDGS air/oil heat exchanger remains closed due to the heat transfer to the cool boost stage fuel flow.

(Ref. Fig. 019) illustrates the transition to a "hot day" cruise operation with hot fuel tanks. If the fuel temperature starts to exceed 246°F, the engine air/oil heat exchanger remains open at full capacity. At fuel temperatures of 260°F, the fuel and engine oil systems are separated to reduce the fuel temperature back to 246°F, where the bypass valve can be closed again. This "cycling" of the oil bypass valve will continue as long as necessary, provided fuel flows remain above min. cruise levels (2000 lbs/hour). If, in addition, the main oil temperature exceeds 320°F, the IDGS air/oil heat exchanger will also open (if not already open) to provide additional cooling.

The configuration for minimum flight idle is shown (Ref. Fig. 020). For this case, the fuel flow could be too low to accept any heat energy from the engine or IDG system. Therefore, the fuel/oil cooler bypass valve is engaged to isolate the fuel from engine oil. Both the IDGS and engine air/oil heat exchanger valves are opened, and the fuel bypass valve reverts to the "upstream mode", sending bypass fuel through both heat exchangers. In this condition, the engine air/oil heat exchanger removes all engine heat generation from the lube system. The IDGS air/oil heat exchanger removes all IDGS heat generation plus some additional heat received from the warmer fuel system. At this condition, both air/oil heat exchangers are enhanced by drawing air from the 2.5 bleed plenum at pressures greater than the fan stream.

As shown (Ref. Fig. 021) the fuel flows at ground idle could be sufficient to absorb the engine heat generation from the oil, depending upon fuel tank temperatures. In this case, the fuel and oil separation is not required and the fuel/oil bypass valve remains closed. However, the IDGs air/oil heat exchanger will be open (commanded open at all idle power settings) and will remove heat from the system.

(6) Thermatic Rotor Control/thrust balance vent management (Ref. Fig. 022)

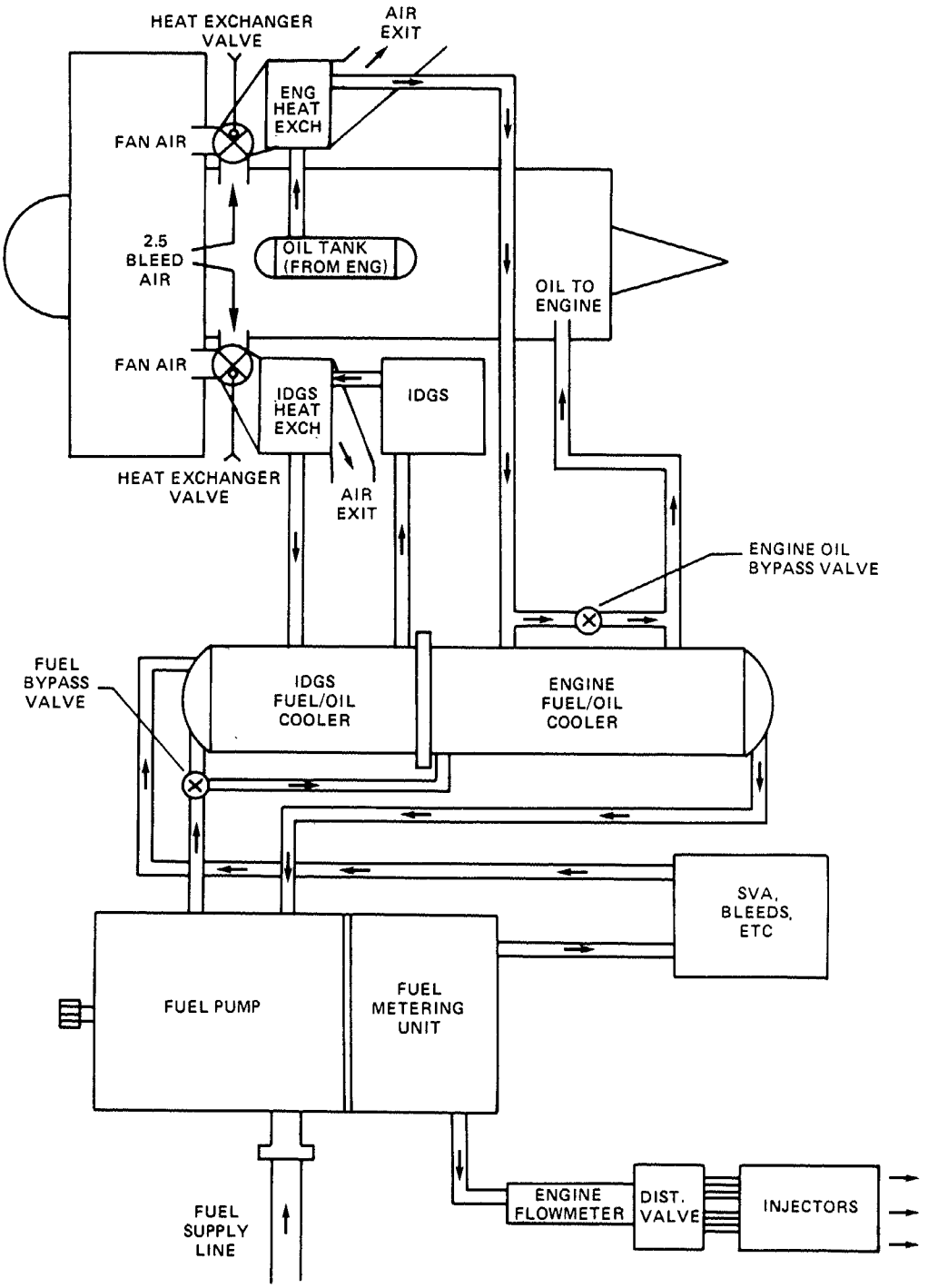
The Thermatic Rotor Control/thrust balance vent valves control 9th stage airflow into the high compressor rotor inner cavity as a function of high rotor speed (N2) and altitude. The FADEC interfaces with the two Thermatic Rotor Control/thrust balance vent valves via two remotely mounted solenoid valve assemblies.

The two Thermatic Rotor Control/thrust balance vent valves provide cooling airflow to the interior high compressor and low turbine areas, provides seal pressurization air, and vents air pressure from the high compressor rear hub area to reduce the No. 2 bearing thrust load.

The Thermatic Rotor Control/thrust balance vent valves are pneumatically operated by high compressor discharge pressure and are designed to flow 9th stage air with the loss of either electrical power or pneumatic pressure.

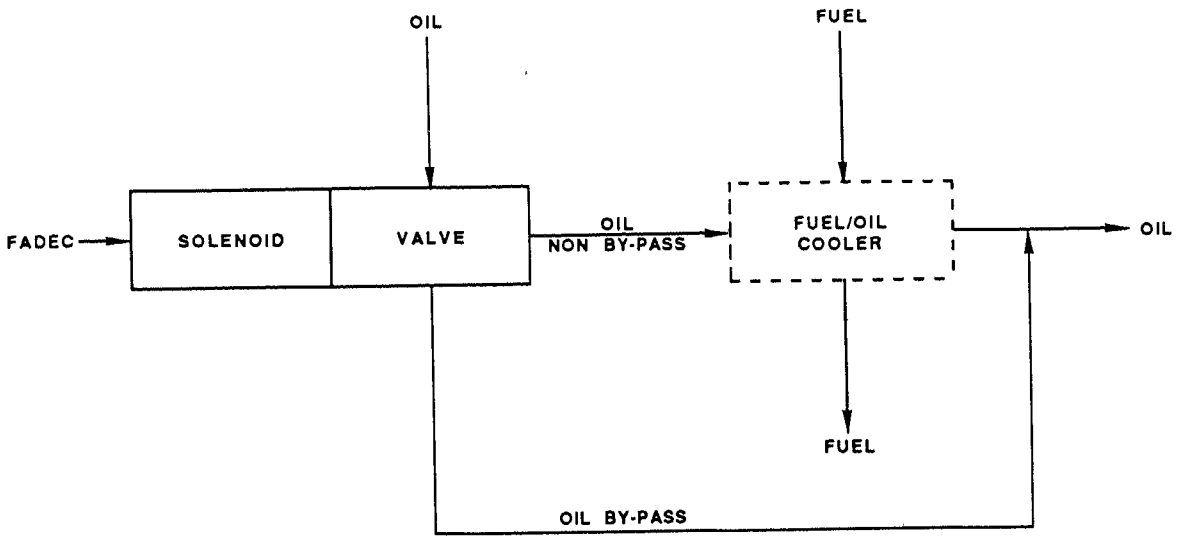
(7) Start/stability bleed management (Ref. Fig. 023)

The two 9th stage compressor stability bleeds are used to facilitate



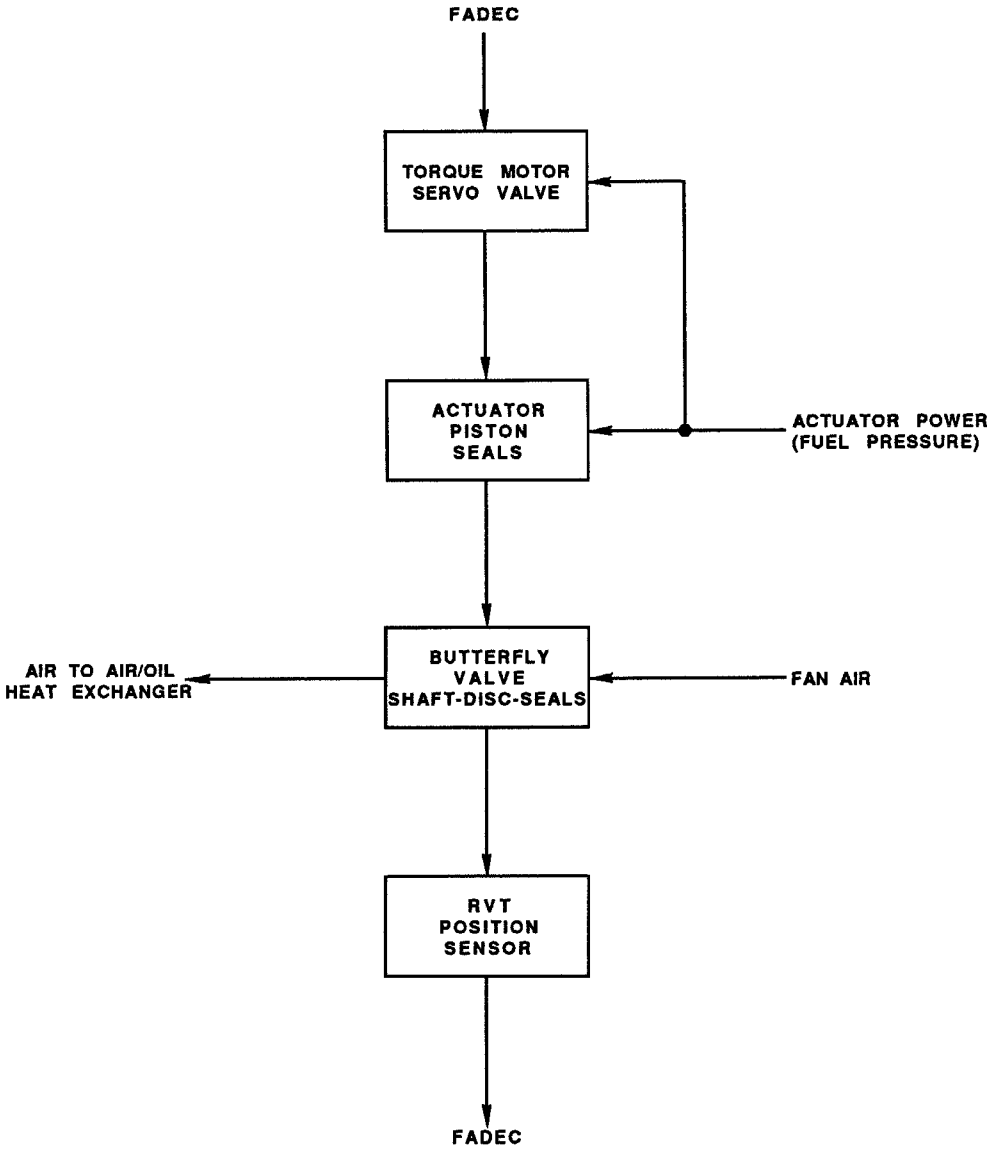
BM5 73 25 00 0 KHAO 23

Heat Exchange System Schematic
Figure 012



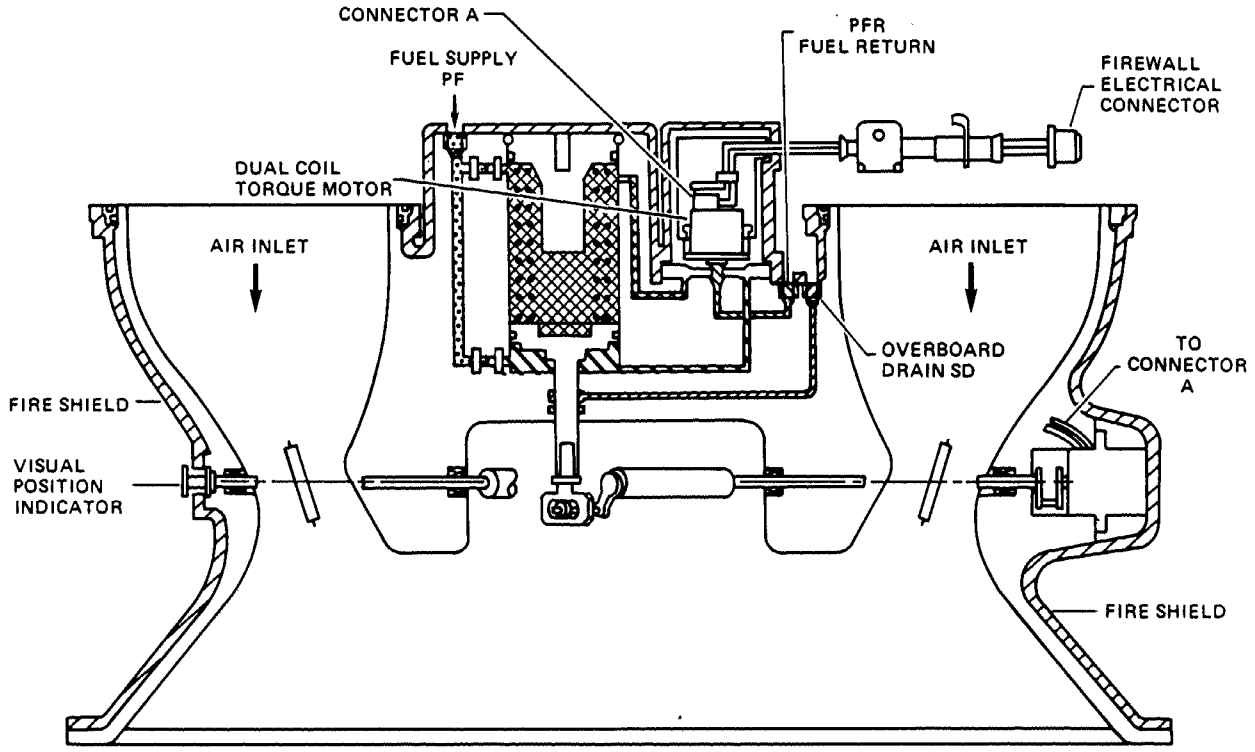
BM5 73 25 00 0 KHCO - 20

Fuel-Oil Cooler Bypass Valve Functional Block Diagram
Figure 013



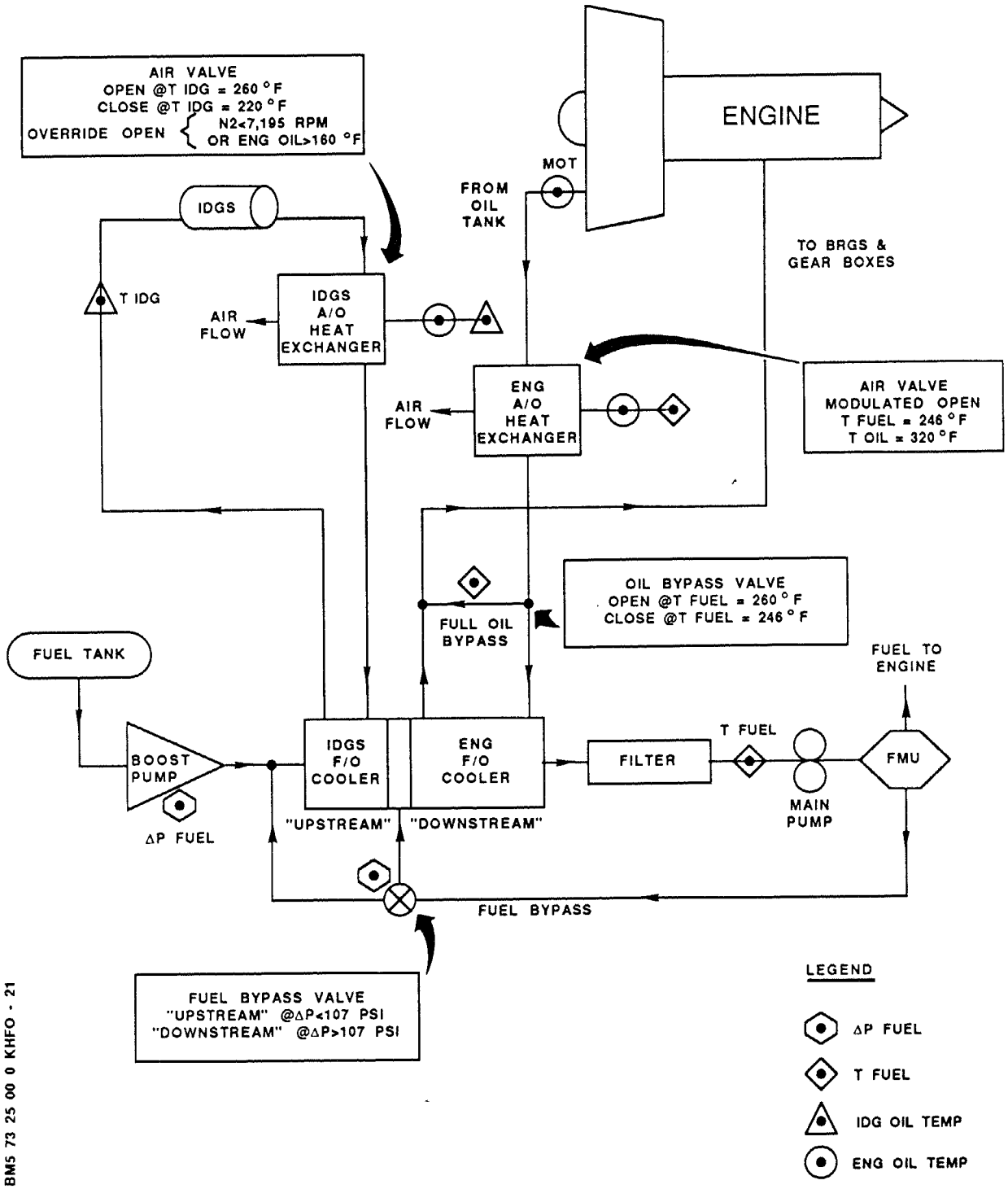
BM5 73 25 00 0 KHDO - 22

Engine Air/Oil Heat Exchanger Valve Functional Block Diagram
Figure 014

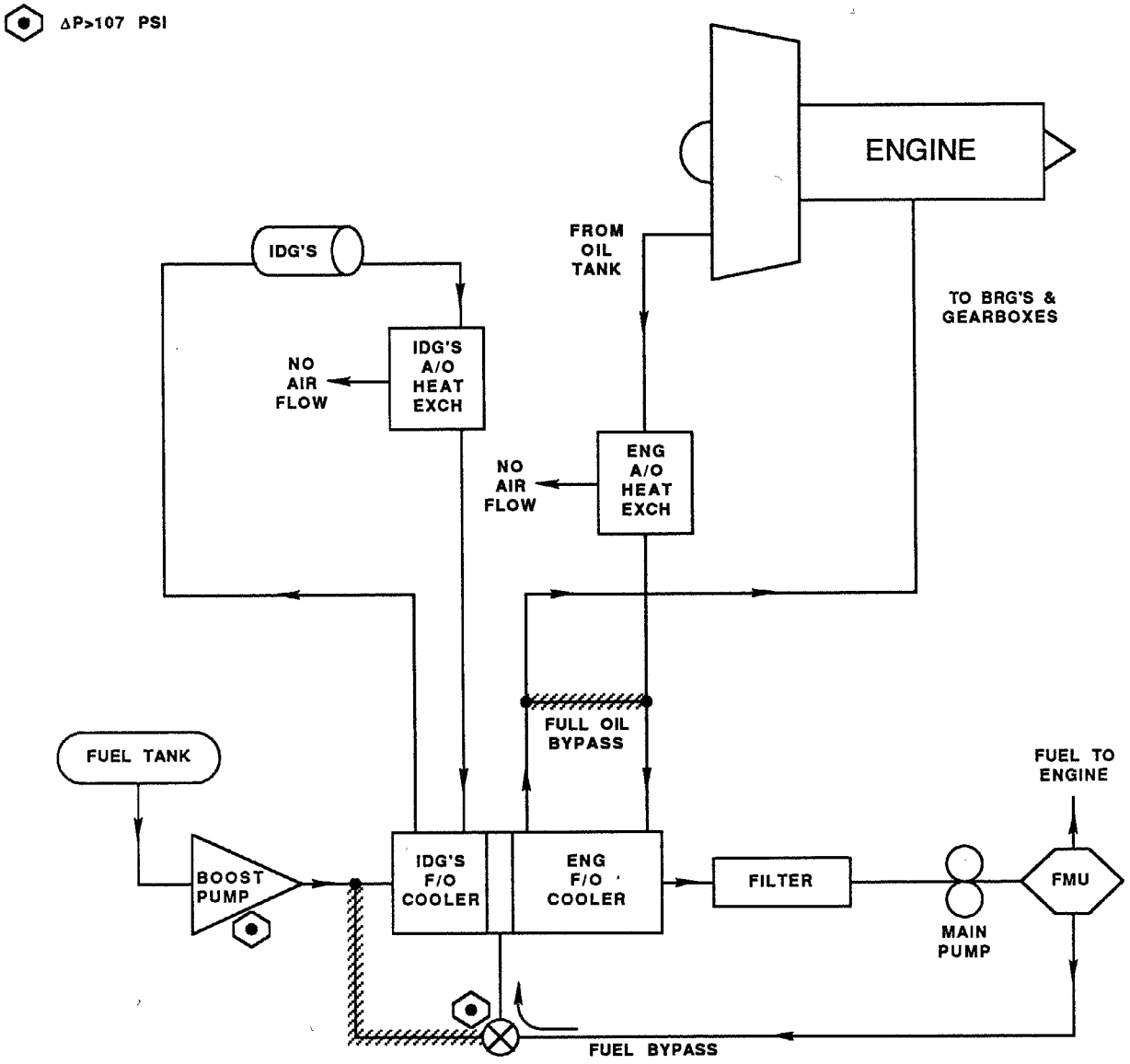


BM5 73 25 00 0 KHEO 20

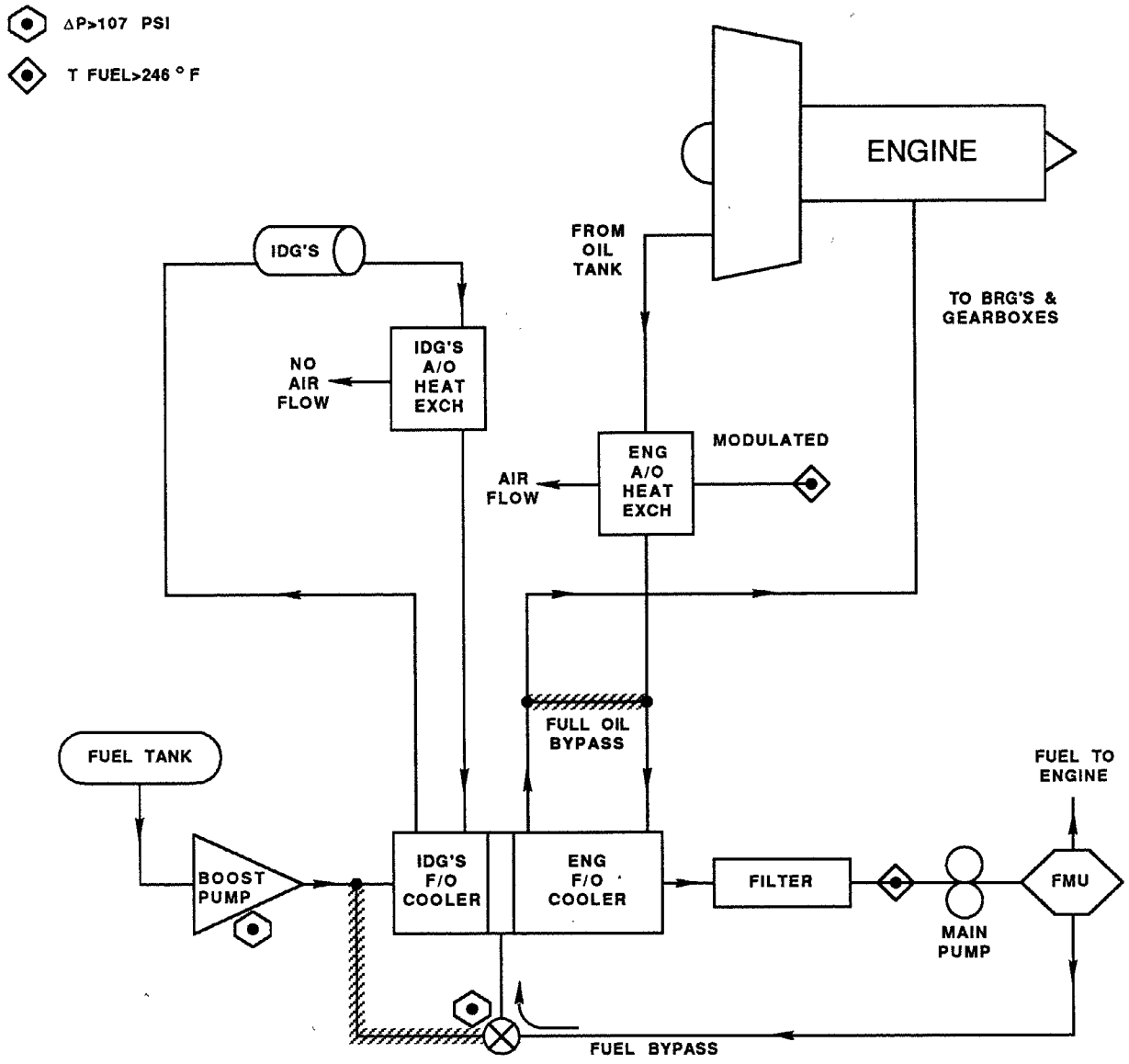
Air/Oil Heat Exchanger Valve Schematic
Figure 015



Oil and Fuel Temperature Management Control Logic
Figure 016

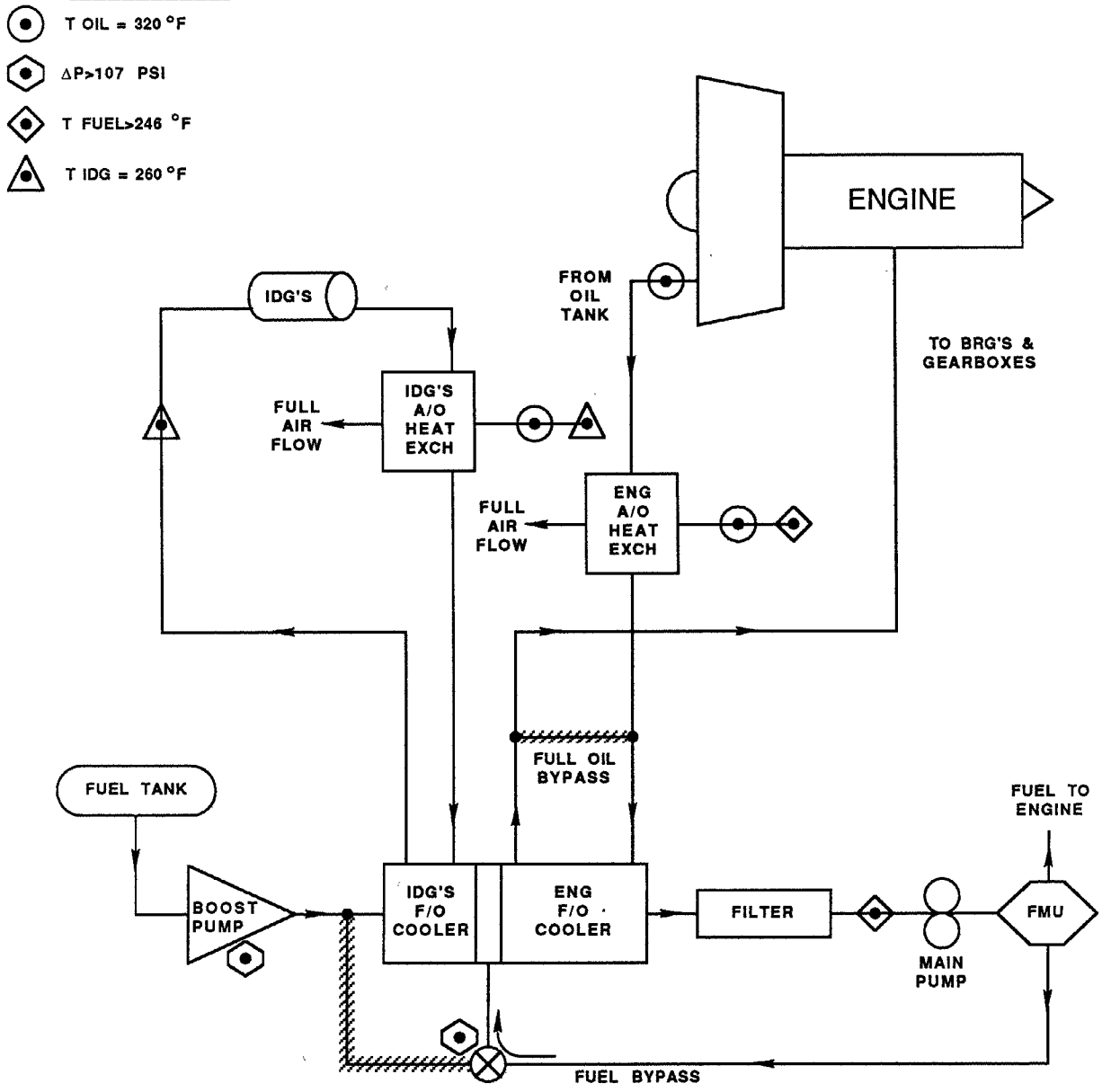


Oil and Fuel Temperature Management Typical Operational Climb/ Take Off
Figure 017



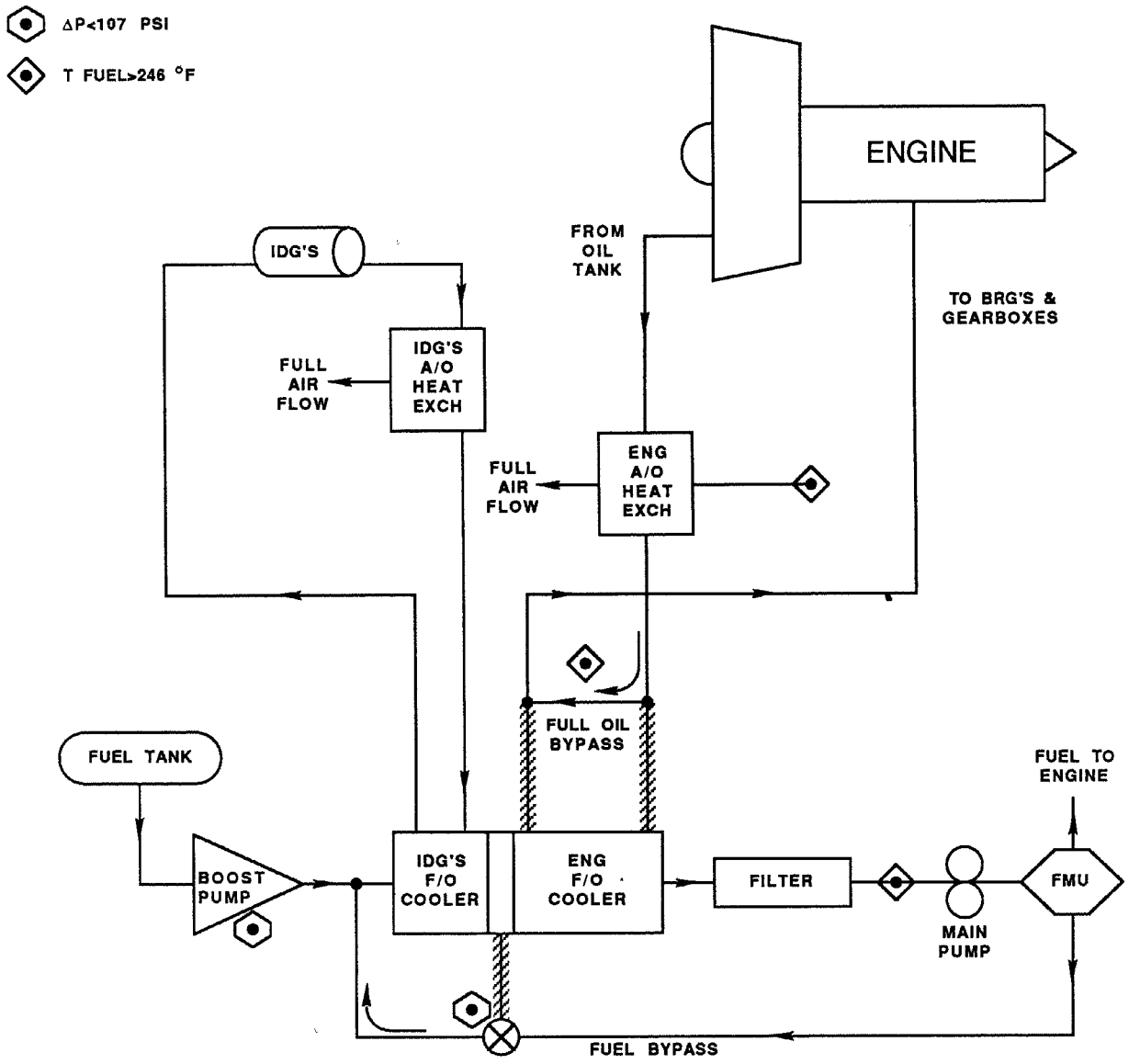
BM5 73 25 00 0 KHHO - 20

Oil and Fuel Temperature Management Typical Cruise Operation
Figure 018



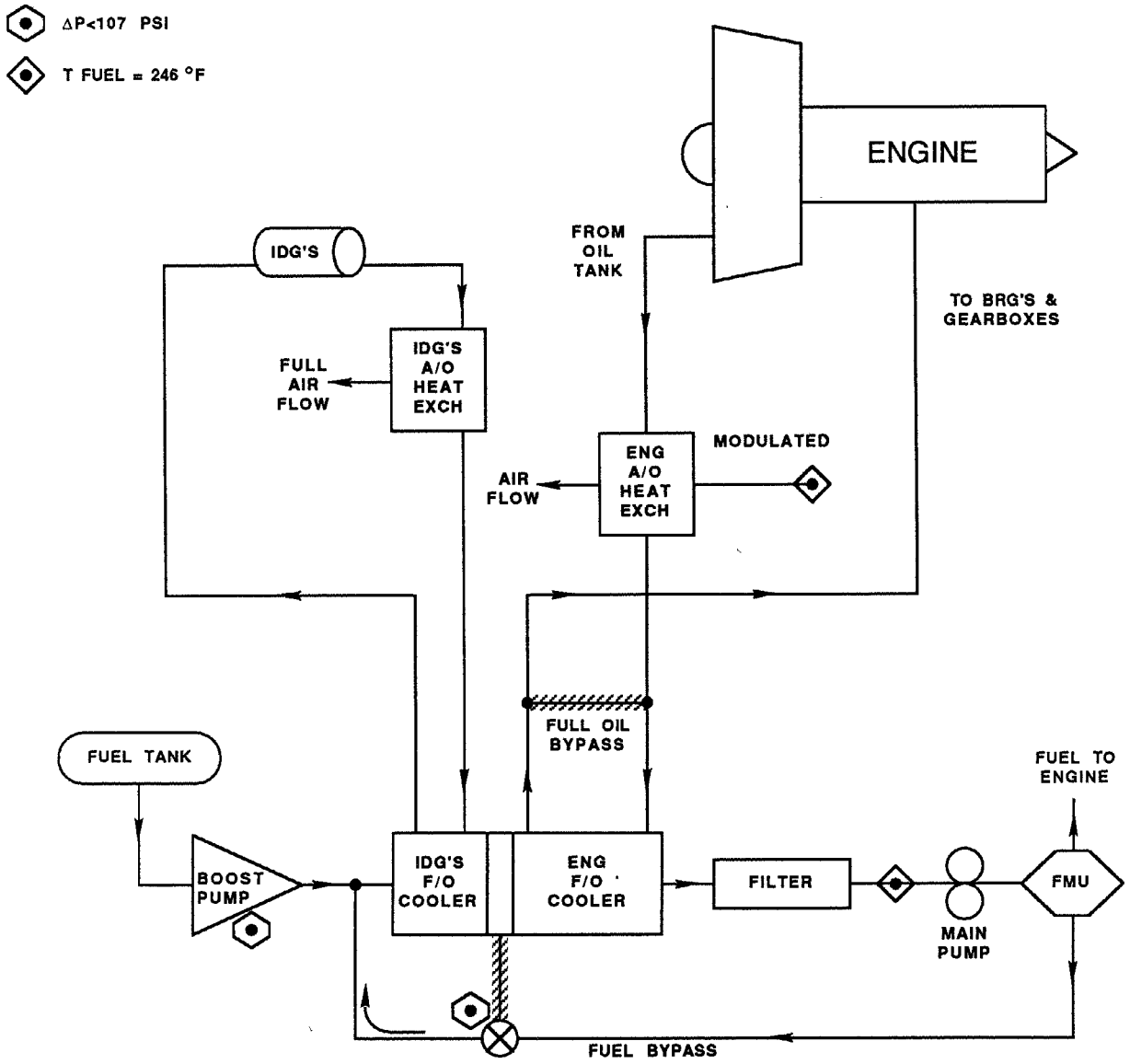
BM5 73 25 00 0 KHJO - 20

Oil and Fuel Temperature Management Typical Operation for "Hot Day" Cruise
Figure 019



BM5 73 25 00 0 KHKO - 20

Oil and Fuel Temperature Management Typical Operation at Flight Idle
Figure 020



BM5 73 25 00 0 KHLO - 20

Oil and Fuel Temperature Management Typical Operation at Ground Idle
Figure 021

engine starting. The bleeds are controlled as a function of high rotor speed (N2) and engine inlet total temperature (T2). The FADEC interfaces with the compressor stability bleed valves through two redundant coil solenoid valve assemblies. The compressor stability bleed valves position is sensed by two thermocouple probes and fed back to the FADEC for maintenance data. The two solenoid valves are remotely mounted as part of a single assembly.
The bleed valve and actuator are an integral assembly. The actuators are powered by compressor discharge pressure. In the event of loss of electrical power compressor stability bleed valve No.1 remains closed and compressor stability bleed valve No.2 opens. In the event of loss of pressure, both compressor stability bleed valves open.

(8)Turbine (blade and vane) cooling air management (Ref. Fig. 024)
Twelfth stage compressor bleed air is used to provide cooling air for the high pressure turbine 2nd vanes and blades. Six cooling air lines are used, four of which are controlled by two pneumatically actuated air shut-off valves. The valves are controlled as a function of high rotor speed (N2) and altitude. The FADEC interfaces with the two turbine (blade and vane) cooling air valves through a remotely mounted solenoid valve assembly. The actuator and valve are an integral assembly.
The switch, actuator and valve are an integral assembly. The actuator is powered by compressor discharge pressure. In the event of a loss of electrical power or pneumatic pressure, the turbine (blade and vane) cooling air valve assemblies are designed to deliver cooling air.

(9)Thrust limiting (Ref. Fig. 026, 027)
The thrust limiting function is used to limit maximum allowable engine thrust when the thrust reverser sleeve is in transit or in case of inadvertent deployment. The position of each of the two thrust reverser sleeves is sensed by a dual coil rotational variable differential transformer. Thrust reverser sleeve position is input directly to the FADEC. The FADEC response to TLA commands is modified based on the status of this input.

(a)FADEC/thrust reverser wiring
Each channel of the FADEC receives a thrust reverser position signal from two independent dual channel, rotational variable differential transducers (RVDT), one located on each reverser sleeve actuator. The FADEC RVDT excitation is wired in parallel to each respective channel of the RVDT. The FADEC senses the electrical average of both reverser sleeves by wiring the feedbacks of the respective RVDT channels in series.

(b)Control of allowable thrust level
The FADEC limits engine thrust during reverser stow and deployment by modifying the measured TRA used by the control laws (Ref. Fig. 027). The feedback position information is used by the FADEC :
- to prevent application of engine power above idle until thrust reverser sleeves reach the commanded position or in case of inadvertent deployment.
- to modulate the thrust as a function of the sleeve position in the end of the sleeve stroke.

**ON A/C 101-105,

Post SB 71-2024 For A/C 101-105,

Post SB 73-2029 For A/C 101-105,

(6)Start/stability bleed management (Ref. Fig.)
The two 9th stage compressor stability bleeds are used to facilitate engine starting. The bleeds are controlled as a function of high rotor speed (N2) and engine inlet total temperature (T2). The FADEC interfaces with the compressor stability bleed valves through two redundant coil solenoid valve assemblies. The two solenoid valves are remotely mounted as part of a single assembly.
The bleed valve and actuator are an integral assembly. The actuators are powered by compressor discharge pressure. In the event of loss of electrical power compressor stability bleed valve No.1 remains closed and compressor stability bleed valve No.2 opens. In the event of loss of pressure, both compressor stability bleed valves open.

(7)Turbine (blade and vane) cooling air management (Ref. Fig. 025)
Twelfth stage compressor bleed air is used to provide cooling air for the high pressure turbine 2nd vanes and blades. Six cooling air lines are used, and controlled by three pneumatically actuated air shut-off valves. The valves are controlled as a function of high rotor speed (N2) and altitude. The FADEC interfaces with the three turbine (blade and vane) cooling air valves through two remotely mounted solenoid valve assembly. The actuator and valve are an integral assembly. The switch, actuator and valve are an integral assembly. The actuator is powered by compressor discharge pressure. In the event of a loss of electrical power or pneumatic pressure, the turbine (blade and vane) cooling air valve assemblies are designed to deliver cooling air.

(8)Thrust limiting (Ref. Fig. 026, 027)
The thrust limiting function is used to limit maximum allowable engine thrust when the thrust reverser sleeve is in transit or in case of inadvertent deployment. The position of each of the two thrust reverser sleeves is sensed by a dual coil rotational variable differential transformer. Thrust reverser sleeve position is input directly to the FADEC. The FADEC response to TLA commands is modified based on the status of this input.

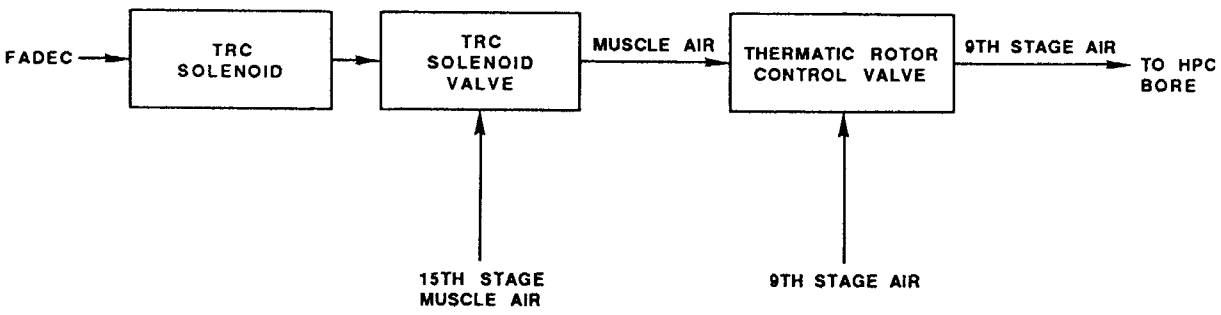
(a)FADEC/thrust reverser wiring
Each channel of the FADEC receives a thrust reverser position signal from two independent dual channel, rotational variable differential transducers (RVDT), one located on each reverser sleeve actuator. The FADEC RVDT excitation is wired in parallel to each respective channel of the RVDT. The FADEC senses the electrical average of both reverser sleeves by wiring the feedbacks of the respective RVDT channels in series.

(b)Control of allowable thrust level

The **FADEC** limits engine thrust during reverser stow and deployment by modifying the measured **TRA** used by the control laws (Ref. Fig. 027). The feedback position information is used by the **FADEC** :

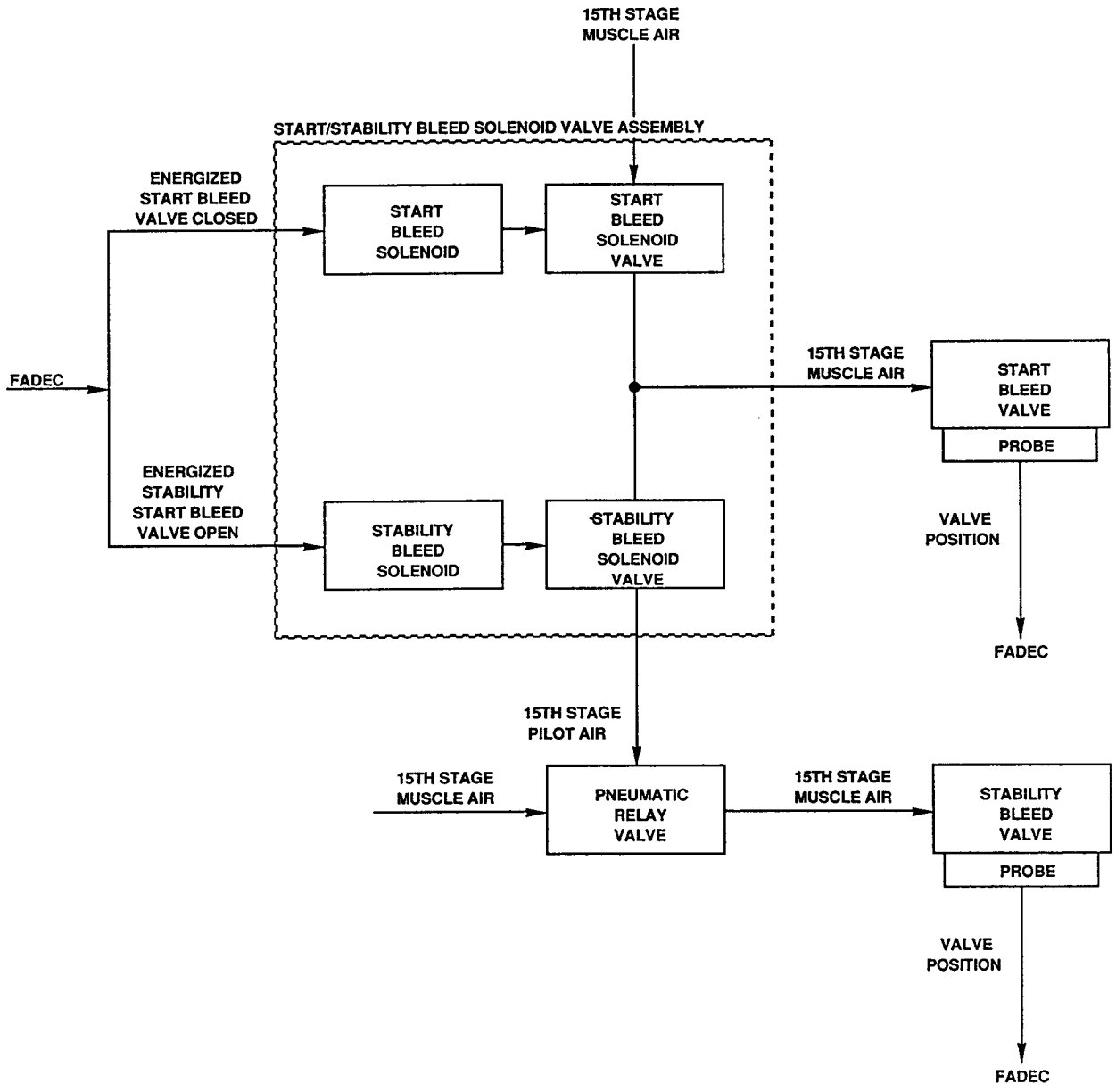
- to prevent application of engine power above idle until thrust reverser sleeves reach the commanded position or in case of inadvertent deployment.
- to modulate the thrust as a function of the sleeve position in the end of the sleeve stroke.

**ON A/C 101-200,



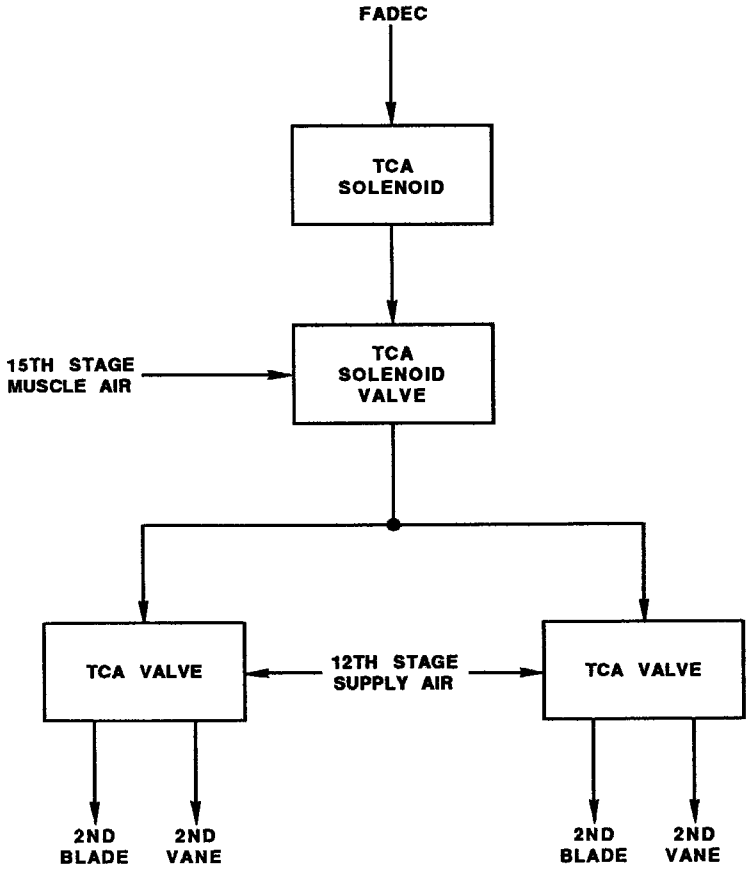
BM5 73 25 00 0 KKA0 00

Thermatic Rotor Control Functional Block Diagram
Figure 022



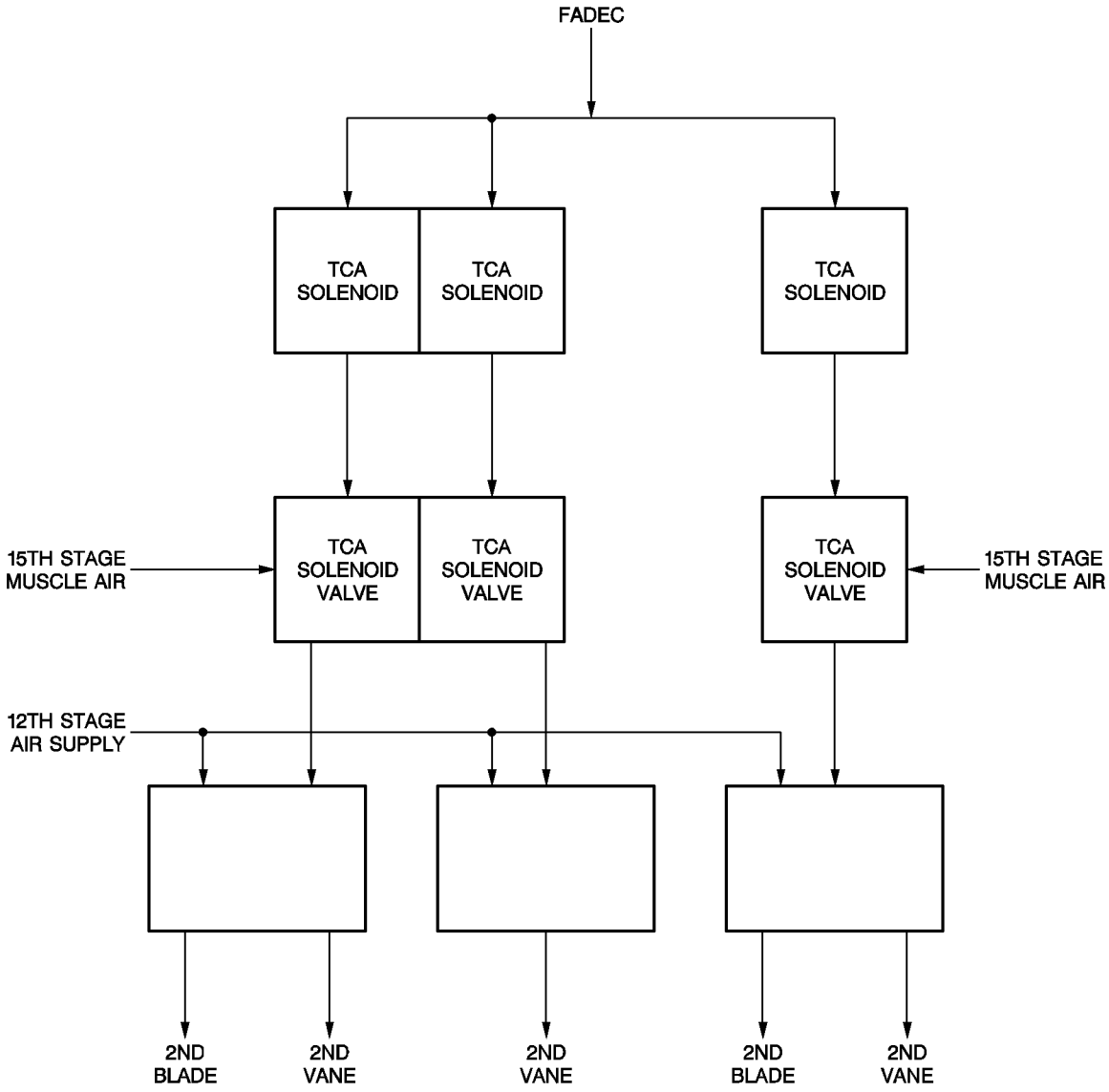
BM5 73 25 00 0 KJFO - 00

Tandem Bleed System Functional Block Diagram
Figure 023



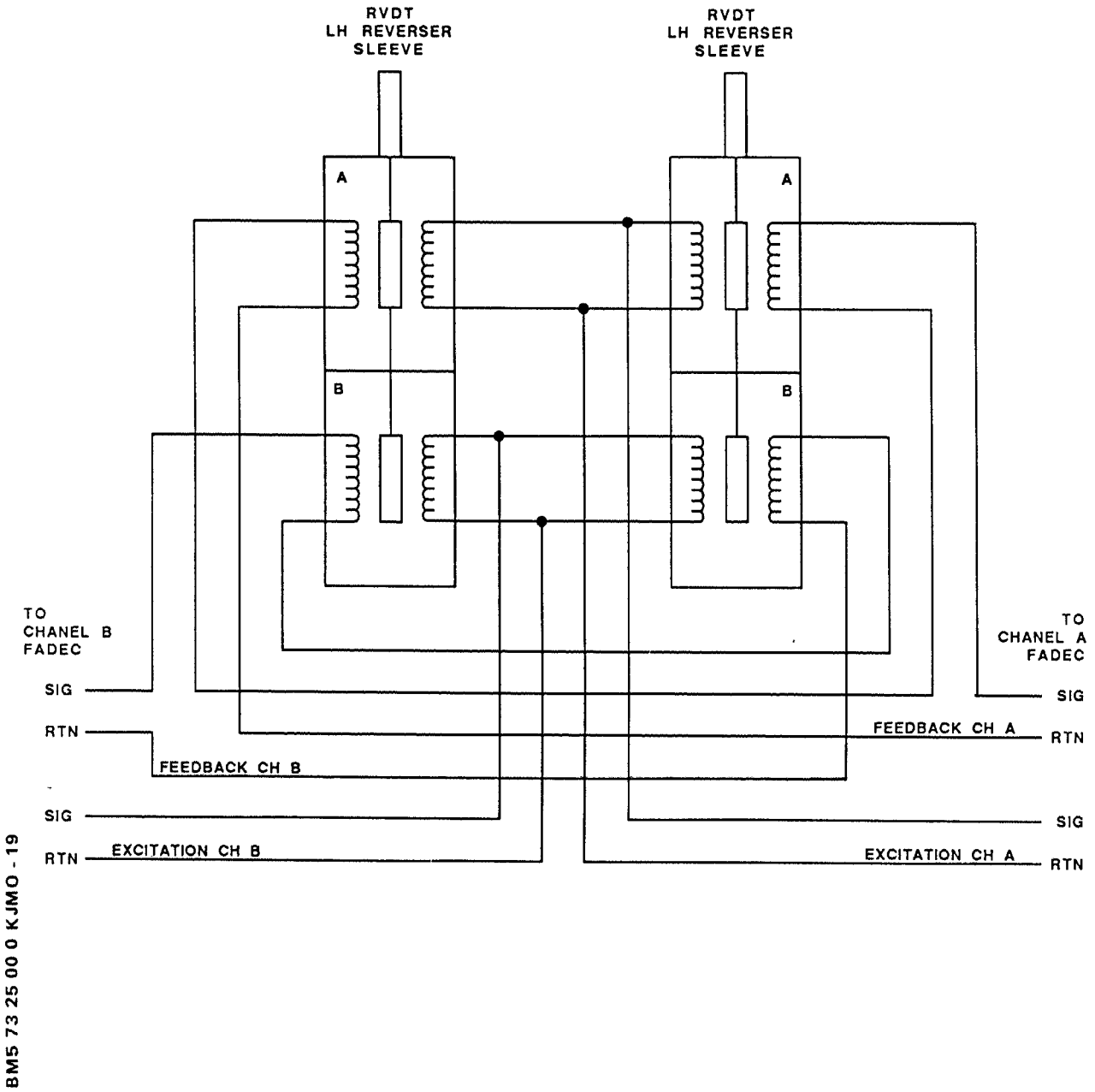
BM5 73 25 00 0 KKE0 00

Turbine Cooling Air System Functional Block Diagram
Figure 024

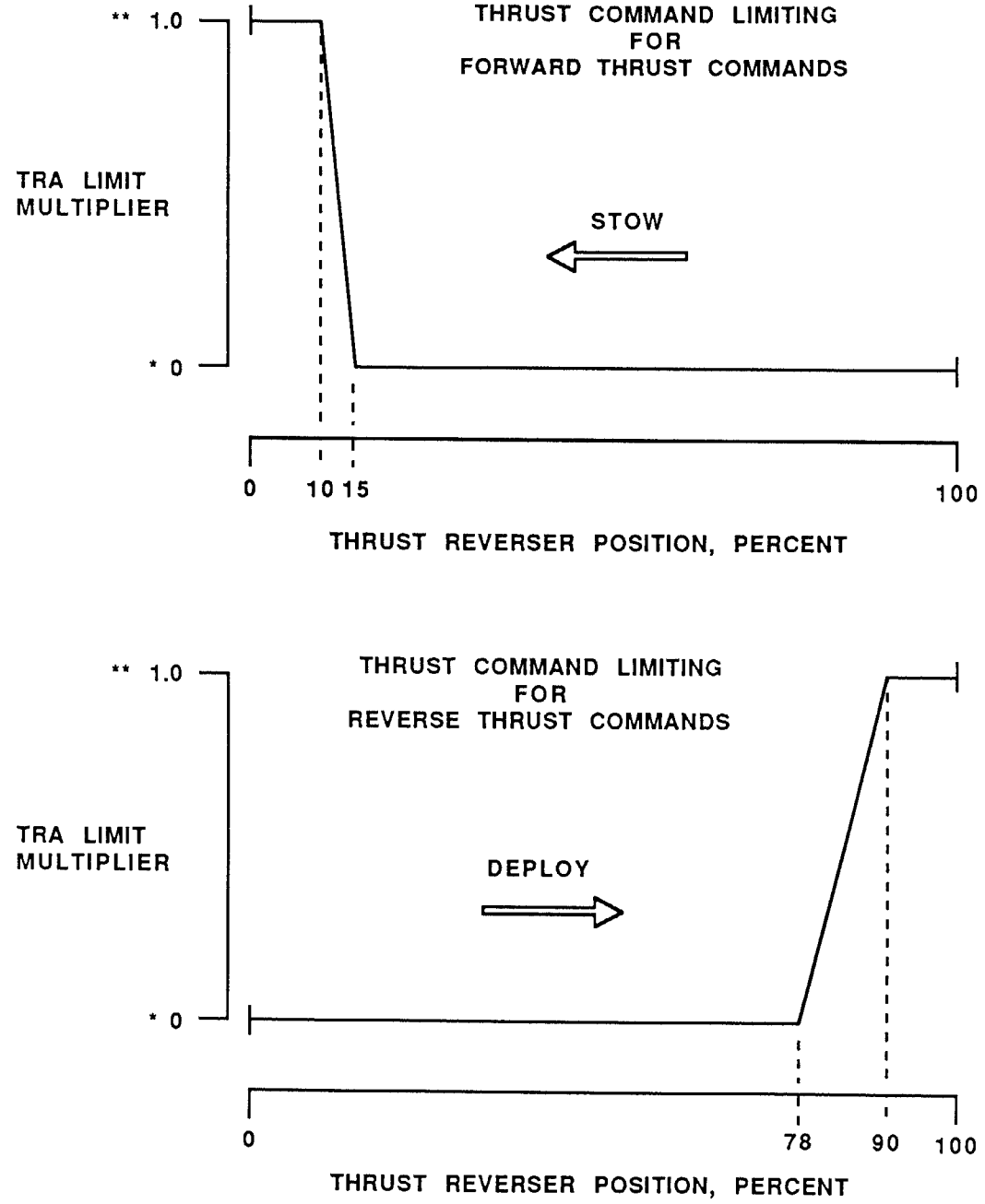


BM5 73 25 00 0 KKT0 00

Turbine Cooling Air System Functional - Block Diagram
Figure 025



FADEC Thrust Reverser Position Detector Crosswiring
Figure 026



** MULTIPLIER CORRESPONDING TO ACTUAL TRA POSITION.
* MULTIPLIER CORRESPONDING TO IDLE TRA POSITION.
TRA : THROTTLE RESOLVER ANGLE.

BM5 73 25 00 0 KLMO - 19

Thrust Limiting During Reverser Transition
Figure 027

C. system Operational and Performance Characteristics (Ref. Fig. 028)
This section presents an overview of the engine control system operational and performance characteristics. It highlights the dual channel, high operational reliability system design philosophy and the soft-ware controlled operating characteristics.

(1)Engine starting
Engine cranking, ignition and fuel are commanded by the crew during both ground starts and in-flight restarts. The FADEC schedules the operation of the compressor stability bleed valves to aid starting and schedules fuel flow during an engine start. The transition to the idle control mode is automatic upon completion of a successful start. Ninth stage air bleed is controlled by two pneumatically actuated flow control valves during an engine start. The FADEC controls the application of pneumatic pressure to the two compressor stability bleed valves during starting by energizing two solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and engine inlet total temperature (T2).
Fuel flow is controlled during the start by the FMU in response to commands from the FADEC. Metering valve position is controlled during a start by scheduling fuel flow/burner pressure (Wf/Pb) as a function of corrected high rotor speed (N2C2) and engine inlet total temperature (T2). The electronic control provides closed loop position control of a torque motor actuated fuel metering valve based on input from a FMU mounted position feedback sensor.

(2)Engine idle control
The engine control system incorporates an isochronous ground idle speed control capability. It will maintain a constant corrected high rotor speed (N2C2) for all ambient and power extraction conditions. This permits a lower ground idle speed and will save fuel and ease ground handling.
The FADEC matches engine idle speed to aircraft requirements. Flight/approach idle speed is increased to a level which will allow the engine to achieve the specified go-around acceleration time. During aircraft descent, engine speed is controlled by either corrected high rotor idle speed (N2C2), minimum fuel flow or a minimum burner pressure bottoming control loop to obtain the minimum idle fuel flow consistent with engine bleed and aircraft pressurization requirements.

(3)Engine acceleration/deceleration control
Engine acceleration and deceleration are controlled against a high rotor speed derivative (N2DOT) limiting schedule biased by altitude. The control logic provides the required engine acceleration and deceleration rates while maintaining engine stability.

(4)Stator vane angle control
Stator vane position is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The stator vane actuator position is scheduled as a function of corrected high rotor speed (N2C25). High compressor inlet temperature (T2.5) is synthesized from corrected low rotor speed (N1C2) and engine inlet total temperature (T2). The stator vane position schedule is selected to provide the appropriate operating efficiency and stability margin for all engine operating

conditions.

(5)Compressor bleed control

Compressor bleeds are provided between the low and high pressure compressors (Station 2.5) and after the 9th stage in the high pressure compressor. The intercompressor (2.5) bleed port is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The intercompressor (2.5) bleed actuator is scheduled as a function of corrected low rotor speed (N1C2) biased by Mach number. Adjustments to the schedule are made based on altitude, high rotor speed (N2) and TLA. During reverse thrust operation and when a stall is detected the bleed is open.

The compressor bleed logic also controls the two 9th stage compressor stability bleed valves in coordination with the intercompressor (2.5) bleed valve. The FADEC applies pneumatic pressure to one or both of two position compressor stability bleed valves through two solenoid control valves.

(6)Engine shut down

Engine shut down is accomplished via a fuel metering unit controlled by the shut-off solenoid which directs fuel pressure to position the sequence valve.

The FADEC is not capable, through either normal functions or malfunctions, of shutting off fuel flow. The FADEC is capable however of commanding the fuel metering valve to a minimum fuel flow stop by energizing a FMU mounted overspeed solenoid valve.

**ON A/C 105-105,

Post SB 71-2024 For A/C 105-105,

C. System Operational and Performance Characteristics (Ref. Fig. 029)
This section presents an overview of the engine control system operational and performance characteristics. It highlights the dual channel, high operational reliability system design philosophy and the software controlled operating characteristics.

(1)Engine starting
Engine cranking, ignition and fuel are commanded by the crew during both ground starts and in-flight restarts. The FADEC schedules the operation of the compressor stability bleed valves to aid starting and schedules fuel flow during an engine start. The transition to the idle control mode is automatic upon completion of a successful start. Ninth stage air bleed is controlled by two pneumatically actuated flow control valves during an engine start. The FADEC controls the application of pneumatic pressure to the two compressor stability bleed valves during starting by energizing two solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and engine inlet total temperature (T2).
Fuel flow is controlled during the start by the FMU in response to commands from the FADEC. Metering valve position is controlled during a start by scheduling fuel flow/burner pressure (Wf/Pb) as a function of corrected high rotor speed (N2C2) and engine inlet total temperature (T2). For engine ground start, a high rotor speed derivative (N2DOT) starting schedule limits the engine acceleration below idle. The electronic control provides closed loop position control of a torque motor actuated fuel metering valve based on input from a FMU mounted position feedback sensor.

(2)Engine idle control
The engine control system incorporates an isochronous ground idle speed control capability. It will maintain a constant corrected high rotor speed (N2C2) for all ambient and power extraction conditions. This permits a lower ground idle speed and will save fuel and ease ground handling.
The FADEC matches engine idle speed to aircraft requirements. Flight/approach idle speed is increased to a level which will allow the engine to achieve the specified go-around acceleration time. During aircraft descent, engine speed is controlled by either corrected high rotor idle speed (N2C2), minimum fuel flow or a minimum burner pressure bottoming control loop to obtain the minimum idle fuel flow consistent with engine bleed and aircraft pressurization requirements.

(3)Engine acceleration/deceleration control
Engine acceleration and deceleration are controlled against a high rotor speed derivative (N2DOT) limiting schedule biased by altitude. The control logic provides the required engine acceleration and deceleration rates while maintaining engine stability.

(4)Stator vane angle control
Stator vane position is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The stator vane actuator position is scheduled as a function of corrected high rotor speed (N2C25). High compressor inlet temperature (T2.5) is synthesized from corrected low rotor speed (N1C2) and engine inlet total temperature (T2).

The stator vane position schedule is selected to provide the appropriate operating efficiency and stability margin for all engine operating conditions.

(5)Compressor bleed control

Compressor bleeds are provided between the low and high pressure compressors (Station 2.5) and after the 9th stage in the high pressure compressor. The intercompressor (2.5) bleed port is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The intercompressor (2.5) bleed actuator is scheduled as a function of corrected low rotor speed (N1C2) biased by Mach number. Adjustments to the schedule are made based on altitude, high rotor speed (N2) and TLA. During reverse thrust operation and when a stall is detected the bleed is open.

The compressor bleed logic also controls the two 9th stage compressor stability bleed valves in coordination with the intercompressor (2.5) bleed valve. The FADEC applies pneumatic pressure to one or both of two position compressor stability bleed valves through two solenoid control valves.

(6)Engine shut down

Engine shut down is accomplished via a fuel metering unit controlled by the shut-off solenoid which directs fuel pressure to position the sequence valve.

The FADEC is not capable, through either normal functions or malfunctions, of shutting off fuel flow. The FADEC is capable however of commanding the fuel metering valve to a minimum fuel flow stop by energizing a FMU mounted overspeed solenoid valve.

**ON A/C 106-200,

C. System Operational and Performance Characteristics (Ref. Fig. 028)
This section presents an overview of the engine control system operational and performance characteristics. It highlights the dual channel, high operational reliability system design philosophy and the software controlled operating characteristics.

(1)Engine starting
Engine cranking, ignition and fuel are commanded by the crew during both ground starts and in-flight restarts. The FADEC schedules the operation of the compressor stability bleed valves to aid starting and schedules fuel flow during an engine start. The transition to the idle control mode is automatic upon completion of a successful start. Ninth stage air bleed is controlled by two pneumatically actuated flow control valves during an engine start. The FADEC controls the application of pneumatic pressure to the two compressor stability bleed valves during starting by energizing two solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and engine inlet total temperature (T2).
Fuel flow is controlled during the start by the FMU in response to commands from the FADEC. Metering valve position is controlled during a start by scheduling fuel flow/burner pressure (Wf/Pb) as a function of corrected high rotor speed (N2C2) and engine inlet total temperature (T2). For engine ground start, a high rotor speed derivative (N2DOT) starting schedule limits the engine acceleration below idle. The electronic control provides closed loop position control of a torque motor actuated fuel metering valve based on input from a FMU mounted position feedback sensor.

(2)Engine idle control
The engine control system incorporates an isochronous ground idle speed control capability. It will maintain a constant corrected high rotor speed (N2C2) for all ambient and power extraction conditions. This permits a lower ground idle speed and will save fuel and ease ground handling.
The FADEC matches engine idle speed to aircraft requirements. Flight/approach idle speed is increased to a level which will allow the engine to achieve the specified go-around acceleration time. During aircraft descent, engine speed is controlled by either corrected high rotor idle speed (N2C2), minimum fuel flow or a minimum burner pressure bottoming control loop to obtain the minimum idle fuel flow consistent with engine bleed and aircraft pressurization requirements.

(3)Engine acceleration/deceleration control
Engine acceleration and deceleration are controlled against a high rotor speed derivative (N2DOT) limiting schedule biased by altitude. The control logic provides the required engine acceleration and deceleration rates while maintaining engine stability.

(4)Stator vane angle control
Stator vane position is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The stator vane actuator position is scheduled as a function of corrected high rotor speed (N2C25). High compressor inlet temperature (T2.5) is synthesized from corrected low rotor speed (N1C2) and engine inlet total temperature (T2).

The stator vane position schedule is selected to provide the appropriate operating efficiency and stability margin for all engine operating conditions.

(5)Compressor bleed control

Compressor bleeds are provided between the low and high pressure compressors (Station 2.5) and after the 9th stage in the high pressure compressor. The intercompressor (2.5) bleed port is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The intercompressor (2.5) bleed actuator is scheduled as a function of corrected low rotor speed (N1C2) biased by Mach number. Adjustments to the schedule are made based on altitude, high rotor speed (N2) and TLA. During reverse thrust operation and when a stall is detected the bleed is open.

The compressor bleed logic also controls the two 9th stage compressor stability bleed valves in coordination with the intercompressor (2.5) bleed valve. The FADEC applies pneumatic pressure to one or both of two position compressor stability bleed valves through two solenoid control valves.

(6)Engine shut down

Engine shut down is accomplished via a fuel metering unit controlled by the shut-off solenoid which directs fuel pressure to position the sequence valve.

The FADEC is not capable, through either normal functions or malfunctions, of shutting off fuel flow. The FADEC is capable however of commanding the fuel metering valve to a minimum fuel flow stop by energizing a FMU mounted overspeed solenoid valve.

**ON A/C 101-104,

Post SB 71-2024 For A/C 101-104,

C. system Operational and Performance Characteristics (Ref. Fig. 029)
This section presents an overview of the engine control system operational and performance characteristics. It highlights the dual channel, high operational reliability system design philosophy and the soft-ware controlled operating characteristics.

(1)Engine starting
Engine cranking, ignition and fuel are commanded by the crew during both ground starts and in-flight restarts. The FADEC schedules the operation of the compressor stability bleed valves to aid starting and schedules fuel flow during an engine start. The transition to the idle control mode is automatic upon completion of a successful start. Ninth stage air bleed is controlled by two pneumatically actuated flow control valves during an engine start. The FADEC controls the application of pneumatic pressure to the two compressor stability bleed valves during starting by energizing two solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and engine inlet total temperature (T2).
Fuel flow is controlled during the start by the FMU in response to commands from the FADEC. Metering valve position is controlled during a start by scheduling fuel flow/burner pressure (Wf/Pb) as a function of corrected high rotor speed (N2C2) and engine inlet total temperature (T2). The electronic control provides closed loop position control of a torque motor actuated fuel metering valve based on input from a FMU mounted position feedback sensor.

(2)Engine idle control
The engine control system incorporates an isochronous ground idle speed control capability. It will maintain a constant corrected high rotor speed (N2C2) for all ambient and power extraction conditions. This permits a lower ground idle speed and will save fuel and ease ground handling.
The FADEC matches engine idle speed to aircraft requirements. Flight/approach idle speed is increased to a level which will allow the engine to achieve the specified go-around acceleration time. During aircraft descent, engine speed is controlled by either corrected high rotor idle speed (N2C2), minimum fuel flow or a minimum burner pressure bottoming control loop to obtain the minimum idle fuel flow consistent with engine bleed and aircraft pressurization requirements.

(3)Engine acceleration/deceleration control
Engine acceleration and deceleration are controlled against a high rotor speed derivative (N2DOT) limiting schedule biased by altitude. The control logic provides the required engine acceleration and deceleration rates while maintaining engine stability.

(4)Stator vane angle control
Stator vane position is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The stator vane actuator position is scheduled as a function of corrected high rotor speed (N2C25). High compressor inlet temperature (T2.5) is synthesized from corrected low rotor speed (N1C2) and engine inlet total temperature (T2). The stator vane position schedule is selected to provide the appropriate operating efficiency and stability margin for all engine operating

conditions.

(5)Compressor bleed control

Compressor bleeds are provided between the low and high pressure compressors (Station 2.5) and after the 9th stage in the high pressure compressor. The intercompressor (2.5) bleed port is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The intercompressor (2.5) bleed actuator is scheduled as a function of corrected low rotor speed (N1C2) biased by Mach number. Adjustments to the schedule are made based on altitude, high rotor speed (N2) and TLA. During reverse thrust operation and when a stall is detected the bleed is open.

The compressor bleed logic also controls the two 9th stage compressor stability bleed valves in coordination with the intercompressor (2.5) bleed valve. The FADEC applies pneumatic pressure to one or both of two position compressor stability bleed valves through two solenoid control valves.

(6)Engine shut down

Engine shut down is accomplished via a fuel metering unit controlled by the shut-off solenoid which directs fuel pressure to position the sequence valve.

The FADEC is not capable, through either normal functions or malfunctions, of shutting off fuel flow. The FADEC is capable however of commanding the fuel metering valve to a minimum fuel flow stop by energizing a FMU mounted overspeed solenoid valve.

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(7)Turbine case cooling control

Turbine case cooling air flow is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The turbine case cooling actuator is scheduled as a function of high rotor speed (N2) and altitude. In general, turbine case cooling is employed at cruise conditions for turbine tip clearance control and at take-off for low pressure turbine structural cooling. A timer is also present to prevent seal wear associated with the application of cooling too soon after engine start up.

- The low pressure turbine case cooling system provides cooling to the LPT case 60 seconds after take-off phase initialization.
- LPT and HPT case cooling system control turbine blade tip clearances during climb or cruise conditions :
  . altitude from 1500 ft to cruise altitude.

(8)Thermatic Rotor Control

Flow of 9th stage compressor bleed air to the interior of the high compressor rotor is controlled by two pneumatically actuated, two position, flow control valves. The FADEC applies pneumatic pressure to the rotor heating control valves by energizing, in parallel, two solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and altitude.

(9)Fuel/oil cooler bypass control

Engine oil flow to the fuel oil cooler is controlled by a solenoid actuated bypass valve. The FADEC causes engine oil to fully bypass the cooler by energizing the solenoid valve. Fuel/oil cooler bypass valve operation is scheduled as a function of fuel flow, fuel temperature, high rotor speed (N2) and engine oil temperature.

**ON A/C 101-105,

Post SB 71-2024 For A/C 101-105,

Post SB 73-2029 For A/C 101-105,

(7)Turbine case cooling control
Turbine case cooling air flow is controlled by a hydraulic actuator. The FADEC provides closed loop control of actuator position based on an input from an actuator mounted position feedback sensor. The turbine case cooling actuator is scheduled as a function of high rotor speed (N2) and altitude. In general, turbine case cooling is employed at cruise conditions for turbine tip clearance control and at take-off for low pressure turbine structural cooling. A timer is also present to prevent seal wear associated with the application of cooling too soon after engine start up.
- The low pressure turbine case cooling system provides cooling to the LPT case 60 seconds after take-off phase initialization.
- LPT and HPT case cooling system control turbine blade tip clearances during climb or cruise conditions :
  . altitude from 1500 ft to cruise altitude.

(8)Thermatic Rotor Control
Not applicable with Phase III configuration.

(9)Fuel/oil cooler bypass control
Engine oil flow to the fuel oil cooler is controlled by a solenoid actuated bypass valve. The FADEC causes engine oil to fully bypass the cooler by energizing the solenoid valve. Fuel/oil cooler bypass valve operation is scheduled as a function of fuel flow, fuel temperature, high rotor speed (N2) and engine oil temperature.

**ON A/C 101-200,

(10)IDG air/oil heat exchanger control
Flow of engine fan exit air to the IDG air/oil heat exchanger is controlled by a hydraulic actuator. The aircraft Generator Control Unit applies hydraulic pressure by energizing an IDG air/oil heat exchanger valve mounted solenoid valve. The engine control system can override the GCU and open the IDG air/oil heat exchanger valve based on engine oil temperature and high rotor speed (N2). The specific logic employed is applied via the GCU.

(11)Engine air/oil heat exchanger control
Flow of engine fan exit air to the air/oil heat exchanger is controlled by a hydraulic actuator. The FADEC provides closed loop control of this

actuator based on fuel temperature. The overall operation of the control loop is a function of fuel temperature, engine oil temperature and high rotor speed (N2). Regulation starts at a fuel temperature of 121°C (250°F). Actuator position feedback is also available to the FADEC.

(12)Turbine cooling air control

Flow of 12th stage compressor bleed air to the high pressure turbine section of the engine is controlled by two pneumatically actuated, two position, flow control valves. The FADEC applies pneumatic pressure to the turbine (blade and vane) cooling air valves by energizing a solenoid control valve. The solenoid control valve is energized as a function of high rotor speed (N2) and altitude.

(13)Overspeed protection (Ref. Fig. 030)

The following design features are used in the FADEC system to minimize the risk of an overspeed :

- FADEC governor schedules are set not to exceed redlines,
- FADEC software is built in redline limits for N1 and N2. FADEC will not allow fuel flow increase if any limit is reached.

These limits are :

- N1 : 111.4%
- N2 : 104.0%
- "If overlimit trip points" would be exceeded (for a period greater than 0.144 seconds as the result of a system failure the overspeed control software and/or hardware prevent the possibility of overspeeding the engine. If N1 or N2 exceed its trip point, the overspeed solenoid is activated and fuel flow is reduced to the minimum flow stop setting.

Trip points are :

- N1 : 117% = 105% redline
- N2 : 110.2% = 106% redline

The overspeed software and hardware is automatically tested during each engine shutdown on the ground. Mach number, N2 and N2DOT are tracked and when the appropriate values are encountered, new, lower trip speeds are set so that an apparent overspeed occurs and the FADEC energizes the dual coil solenoid valve located in the FMU. Fuel metering valve position is monitored and if it does not reach the minimum flow position within a specified time the overspeed system is flagged as not working properly.
The overspeed protection is provided in hardware and software in each FADEC channel. Each channel's overspeed fuel flow cutback solenoid is controlled by a high side (28VDC) and low side (ground) switches.
The low side switch is controlled by a hardware counter independent from the processor. The high side switch is controlled either by software, or by the hardware counter of the opposite channel via hardwires between the channels.
Thus the hardware is capable of energizing the overspeed solenoid regardless of software status. As shown (Ref. Fig. 030) the channel A software command is "OR'd" with the channel B hardware command then "AND'd" with the channel A hardware command to energize the channel A overspeed solenoid coil. Likewise, the channel B software command is "OR'd" with the channel A hardware command then "AND'd" with the channel B hardware command to energize the channel B overspeed solenoid coil.

- The software process takes the selected rotor speed and compares it to

a programmed constant. The speed is selected from the local processor's counter and the value from the opposite channel via the high speed digital cross link.

- The parts common to both the hardware and software functions, in each channel, are the power supply and the clock (frequency standard).

(14)FADEC initialization

Initialization is the first state to be entered upon power-up of the control. During initialization various tests are performed to determine whether the channel can control the engine. Included in the initialization state are RAM, EEROM and pressure sensor data initialization. The maximum initialization time is 1.5 seconds. During initialization, the digital data bus output of the FADEC is inoperative. Immediately following initialization, the FADEC starts transmitting valid data. Initialization has no impact on the analog N1 signal.
There are two forms of initialization, a Power Supply Reset (PSR) and a Processor On Reset (POR). A power supply reset will occur when supply voltage recovers from an out-of-range to in-range value, as occurs on power-up. A POR will result from a PSR, an external reset, or if an internal fault is detected.

(15)Channel switching logic

The purpose of the switchover logic is to determine which channel should be in control of the redundant outputs and to schedule the self testing of the control system. To decide which channel should be in control, the individual channels must first determine if they have available to them, all the inputs and outputs required for each of their redundant loops. After determining the loop status, the channel health is determined based on the following table which is listed in order of increasing health. This is a weighted table such that fuel and/or stator vane health are dominant.

- Cannot command the fuel valve
- Cannot command the stator vane actuator
- Cannot command the 2.5 bleed actuator
- Cannot command the start bleed
- Cannot command the tandem/surge bleed
- Cannot command the air/oil heat exchanger valve
- Cannot command the oil bypass solenoid
- Cannot command the turbine case cooling valve

Once each channel has determined its health, it compares its health with the health reported by the other channel, via cross link data, and the healthiest channel takes control.
A channel switchover will not cause an engine transient. As the result of failure of an output interface, an actuator may be slightly off schedule prior to failure detection. If this should occur, then the channel switchover transient will be the result of the actuator returning to the scheduled position. If a channel switchover results in the most capable channel having to failsafe one or more of its outputs, a transient to the failsafe position can be expected.

**ON A/C 101-105,

(10)IDG air/oil heat exchanger control
Flow of engine fan exit air to the IDG air/oil heat exchanger is controlled by a hydraulic actuator. The aircraft Generator Control Unit applies hydraulic pressure by energizing an IDG air/oil heat exchanger valve mounted solenoid valve. The engine control system can override the GCU and open the IDG air/oil heat exchanger valve based on engine oil temperature and high rotor speed (N2). The specific logic employed is applied via the GCU.

(11)Engine air/oil heat exchanger control
Flow of engine fan exit air to the air/oil heat exchanger is controlled by a hydraulic actuator. The FADEC provides closed loop control of this actuator based on fuel temperature. The overall operation of the control loop is a function of fuel temperature, engine oil temperature and high rotor speed (N2). Regulation starts at a fuel temperature of 121°C (250°F). Actuator position feedback is also available to the FADEC.

(12)Turbine cooling air control
Flow of 12th stage compressor bleed air to the high pressure turbine section of the engine is controlled by three pneumatically actuated, two position, flow control valves. The FADEC applies pneumatic pressure to the turbine (blade and vane) cooling air valves by energizing three solenoid control valves. The solenoid control valves are energized as a function of high rotor speed (N2) and altitude. Turbine (blade and vane) cooling air valve status is fed back to the FADEC from a position switch on one of the valves. This information is used for system diagnostics.

(13)Overspeed protection (Ref. Fig. 030)
The following design features are used in the FADEC system to minimize the risk of an overspeed :
- FADEC governor schedules are set not to exceed redlines,
- FADEC software is built in redline limits for N1 and N2. FADEC will not allow fuel flow increase if any limit is reached.

These limits are :
- N1 : 111.4%
- N2 : 104.0%
- "If overlimit trip points" would be exceeded (for a period greater than 0.144 seconds as the result of a system failure the overspeed control software and/or hardware prevent the possibility of overspeeding the engine. If N1 or N2 exceed its trip point, the overspeed solenoid is activated and fuel flow is reduced to the minimum flow stop setting.

Trip points are :
- N1 : 117% = 105% redline
- N2 : 110.2% = 106% redline

The overspeed software and hardware is automatically tested during each engine shutdown on the ground. Mach number, N2 and N2DOT are tracked and when the appropriate values are encountered, new, lower trip speeds are set so that an apparent overspeed occurs and the FADEC energizes the dual

coil solenoid valve located in the FMU. Fuel metering valve position is monitored and if it does not reach the minimum flow position within a specified time the overspeed system is flagged as not working properly. The overspeed protection is provided in hardware and software in each FADEC channel. Each channel's overspeed fuel flow cutback solenoid is controlled by a high side (28VDC) and low side (ground) switches. The low side switch is controlled by a hardware counter independent from the processor. The high side switch is controlled either by software, or by the hardware counter of the opposite channel via hardwires between the channels.
Thus the hardware is capable of energizing the overspeed solenoid regardless of software status. As shown (Ref. Fig. 030) the channel A software command is "OR'd" with the channel B hardware command then "AND'd" with the channel A hardware command to energize the channel A overspeed solenoid coil. Likewise, the channel B software command is "OR'd" with the channel A hardware command then "AND'd" with the channel B hardware command to energize the channel B overspeed solenoid coil.

- The software process takes the selected rotor speed and compares it to a programmed constant. The speed is selected from the local processor's counter and the value from the opposite channel via the high speed digital cross link.
- The parts common to both the hardware and software functions, in each channel, are the power supply and the clock (frequency standard).

(14)FADEC initialization

Initialization is the first state to be entered upon power-up of the control. During initialization various tests are performed to determine whether the channel can control the engine. Included in the initialization state are RAM, EEROM and pressure sensor data initialization. The maximum initialization time is 1.5 seconds. During initialization, the digital data bus output of the FADEC is inoperative. Immediately following initialization, the FADEC starts transmitting valid data. Initialization has no impact on the analog N1 signal.
There are two forms of initialization, a Power Supply Reset (PSR) and a Processor On Reset (POR). A power supply reset will occur when supply voltage recovers from an out-of-range to in-range value, as occurs on power-up. A POR will result from a PSR, an external reset, or if an internal fault is detected.

(15)Channel switching logic

The purpose of the switchover logic is to determine which channel should be in control of the redundant outputs and to schedule the self testing of the control system. To decide which channel should be in control, the individual channels must first determine if they have available to them, all the inputs and outputs required for each of their redundant loops. After determining the loop status, the channel health is determined based on the following table which is listed in order of increasing health. This is a weighted table such that fuel and/or stator vane health are dominant.

- Cannot command the fuel valve
- Cannot command the stator vane actuator
- Cannot command the 2.5 bleed actuator
- Cannot command the start bleed

- Cannot command the tandem/surge bleed
- Cannot command the air/oil heat exchanger valve
- Cannot command the oil bypass solenoid
- Cannot command the turbine case cooling valve

Once each channel has determined its health, it compares its health with the health reported by the other channel, via cross link data, and the healthiest channel takes control.

A channel switchover will not cause an engine transient. As the result of failure of an output interface, an actuator may be slightly off schedule prior to failure detection. If this should occur, then the channel switchover transient will be the result of the actuator returning to the scheduled position. If a channel switchover results in the most capable channel having to failsafe one or more of its outputs, a transient to the failsafe position can be expected.

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(16)Mode characteristics

Each channel of the FADEC has two control modes :

- primary control mode : EPR
- alternate control mode : N1.

(a)EPR mode (Ref. Fig. 031)

The EPR mode of the control is the normal mode. EPR is the thrust rating parameter for the engine. The control logic is designed to permit power setting to the ratings when in the EPR mode. The FADEC calcultes the thrust ratings based on T2, altitude and Mach number. Ratings are calculated for Take-Off/Go-Around, Maximum Continuous and Maximum Climb. These ratings are then modified appropriately to account for service bleed extraction such as air packs or anti-icing bleeds. After establishing the ratings, the desired EPR is calculated based upon the TRA. The schedules are established such that TLA vs. thrust is essentially linear from idle to maximum. Maximum available EPR is always achieved at full throttle and maximum climb is always attained at the same TRA setting.

The EPR mode provides closed loop power setting as function of EPR. Fuel flow is adjusted by an EPR error at conditions above idle. At idle N1, N2 or Pb error terms are used depending on flight and engine operating conditions.

(b)Alternate mode (Ref. Fig. 032)

In the event the engine control system is unable to operate closed loop on engine pressure ratio, an alternate control mode (N1) is available. The alternate mode schedules low rotor speed (N1) as a function of thrust lever angle and engine inlet total temperature. The N1 mode is not a rated mode of operation thus TRA vs. thrust will vary over the flight envelope and a full forward throttle could result in an overboost. When the FADEC is operating in the N1 mode after an automatic mode reversion or a manual selection, the EPR command labels from both channels are flagged with Failure Warning (FW) on the SSM and the corresponding EPR command indication in the flight compartment is also flagged (Ref. 77-00-00).

The Alternate Mode Select discrete, controlled from the MODE SELECT

pushbutton switch (on overhead panel 429VU), allows the crew to manually select the N1 mode.
The N1 mode is the normal mode of operation in reverse. Full rated reverse thrust is achieved at maximum reverse thrust lever position for either forward modes (N1 or EPR).
- Since in reverse the normal control mode is the N1 mode ; in the absence of failure, EPR command is set equal to EPR actual.

Remark : in N1 mode, the Thrust Control Computer is automatically disconnected.

(c)Mode switching (Ref. Fig. 033)
In the event the FADEC system is unable to control the engine in EPR mode, the alternate mode is automatically used by the control. The reversion to the alternate mode does not affect the FADEC system ability to provide the required thrust.
During and after this automatic reversion, thanks to a lock up logic, the thrust is maintained and the power setting parameters unchanged to avoid an immediate crew action.
The lock-up logic is defined to ensure that, during the take-off phase, the FADEC provides a thrust at least equivalent to that achieved in the primary mode at the time of failure.
A manual selection of the N1 mode removes the lock-up logic, and allows the control of the engine in N1 mode without the ΔN1 correction adapted to cover the take-off phase. For the rest of the flight, the rated thrust is achieved by manually setting N1 with the throttle control lever.

(d)Mode recovery
The mode select switch can be used to transition from the N1 mode back to the EPR mode if the fault on air data which caused a reversion is cleared.
This does not reset the processor but simply allows a reselection of a healthy EPR mode.

(17)Thrust management and rating control

(a)Rating control (Ref. Fig. 034)
Engine pressure ratio (EPR) is normally used to set steady state power conditions above idle. The desired engine pressure ratio is established by the control based on TLA, T2, altitude and Mach number. In addition, aircraft discretes indicating the status of air conditioning bleed and anti-icing bleed are provided to appropriately modify the selected rating. The TLA selected EPR command is compared with the EPR sensed by the FADEC. The control logic varies fuel flow in a manner to make actual EPR equal to EPR command. The sensed EPR signal, the calculated TLA commanded EPR and the calculated EPR and the calculated EPR rating limits are provided on a digital data link to the flight compartment for display.
If, due to sensor and/or control hardware problems, the engine control system is unable to close the loop on EPR, an alternate control mode is available. The alternate control mode schedules low rotor speed (N1) as a function of TLA and engine inlet total temperature (T2).

(b)Thrust management
(Ref. Fig. 035)
The engine pressure ratio based engine rating control concept made

possible by the full authority electronic control substantially reduces crew workload associated with engine thrust setting. The FADEC establishes engine power through direct closed-loop control of engine pressure ratio. Scheduled engine pressure ratio is calculated in the FADEC. The engine pressure radio schedules are implemented to obtain the following :

1 Engine pressure ratio ratings at unique TLA positions
- Take-off limit at full forward TLA
- Maximum continuous thrust and maximum climb thrust, at unique TLA

2 Reverse limit at full reverse TLA

3 Correct rating at constant TLA with changing flight or environmental conditions

4 Essentially linear thrust versus TLA

5 Consistent thrust lever sensitivity

6 Controlled take-off lapse rate

7 Automatic adjustment to ratings for bleed extraction.

In addition, engine power setting workload is reduced through the following :
- Low throttle forces
- No power-setting hysteresis
- Crisp thrust response
- Automatic engine limit protection.

(Ref. Fig. 035) shows a typical EPR setting versus TLA schedule as used in the control. The control enables consistent TLA vs. thrust characteristics according to the schedules programmed in the control. Further, it prevents inadvertent overboosting of the engine and provides consistent acceleration time capability. The EPR command value calculated in the FADEC is transmitted to the flight compartment for display on the EPR indicator (Ref. Fig. 035).

To set thrust, the pilot only has to set the TLA position which results in lining up the EPR command from the FADEC with the "Reference Indicator" from the Thrust Control Computer. The engine control system will automatically accelerate or decelerate the engine to that EPR level without the pilot having to continually monitor the EPR indicator.

Once a power setting has been selected via the TLA input, it will be maintained by the control system, until the throttle control lever is repositioned, despite changes in flight or environmental conditions.

Therefore, constant TLA settings can be used for climb. In addition, the same thrust rating will be obtained on each engine at the same value of TLA, thereby eliminating throttle control lever stagger. This is because the pilot sets engine thrust according to EPR by selecting a specific TLA and the system controls closed loop on engine pressure ratio.

(c)Rating logic

1 General

The power settings are calculated for maximum power available (take-off at and below 14,100 feet and maximum continuous above 14,100 feet), maximum climb and idle. These ratings are defined in order to achieve EPRTO greater than EPRMCN greater than EPRMCL in the

overall engine operational envelope with a single rating computation for each rating. A minimum Mach number of 0.1 is used for calculation of all rating parameters within the control. Deltas are added to account for the service bleed extraction required by the aircraft. The interpolation of the ratings is performed as a function of throttle control lever resolver angle (TRA) so that thrust is essentially linear with TRA for all operating conditions.

2 Calculation of rating altitude, breakpoint temperature and delta ambient temperature.

The "rating altitude" represents the field altitude which is used for calculation of the take-off rating. The "rating altitude" is the altitude that is used to enter the power settings polynomials. It is equal to the measured altitude for all power settings except maximum power available where, at or below 14,100 ft. (take-off envelope), it is automatically set equal to the field altitude where the flight was initiated. For take-off, the field altitude remains the "rating altitude" until the aircraft exits the take-off envelope. Once this has occured the "rating altitude" is equal to measured altitude for the duration of the flight.

The breakpoint temperature separates the two distinct modes of gas generator operation for all defined power settings except idle. Above the breakpoint temperature the power setting schedules result in constant turbine inlet temperature and below the breakpoint temperature constant EPR (thrust) is maintained. Engine take-off is flat rated to ambient temperatures that vary as a function of altitude while the other ratings are flat rated at ambient temperatures less than Std + a constant.

3 Calculation of ratings

The maximum power setting is equal to the take-off rating at or below 14,100 feet and maximum continuous rating above 14,100 feet. This power setting is obtained at the maximum TRA position. The take-off portion is calculated as a function of measured inlet total temperature or take-off breakpoint temperature (whichever is higher), Mach number, "rating altitude" and delta ambient temperature. EPR resets of service bleed extraction (which are summed together to form DLEPR) are added to the base take-off rating. The process for operation above 14,100 feet is similar, except a breakpoint temperature of Std + a constant.

The maximum continuous and maximum climb power settings are biased with essentially the same parameters as the take-off rating.

The FADEC logic provides protection during temperature inversion take-offs to assure that the EPR will not decrease below the envelope that would be achieved during a non-inversion take-off.

The idle EPR reference is calculated from altitude and Mach number with a flight idle bias, but is not used to control at idle. It is only calculated to allow a linear interpolation between idle and other power conditions as a function of TRA.

The idle power setting is established by selecting between schedule values of corrected high compressor rotor speed, burner pressure and minimum fuel flow. The idle system selects the scheduled value which provides the higher engine power. A burner pressure level sufficient

to provide bleed pressure at the exit of the service bleed ports is scheduled as a function of altitude. Because bleed pressure requirements also vary as a function of service bleed configuration, the service bleed discretes are used to automatically reset the burner pressure schedule.

The FADEC logic permits a flexible take-off procedure with constant retarded throttle position, allowing the application of full take-off power if desired. At this retarded throttle control lever position, the logic is defined such that the thrust obtained all along the flexible take-off at the calculated ambient temperature will be at least the same, excluding temperature inversion conditions, as the thrust obtained during a maximum take-off at an actual ambient temperature equivalent to assumed temperature.

4 Interpolation of power setting schedules

The ratings are interpolated to generate an EPR take-off (EPRTO) which provides the rating to be used at maximum TRA as a function of altitude and Mach number.

The schedules are interpolated to generate an EPR reference (EPRRF) which provides, during normal operation, an essentially linear relationship between thrust and TRA with thrust increasing and decreasing as TRA increases and decreases respectively.

(18) FADEC system self-test and fail-safe capabilities

(a) Self-test features

The FADEC incorporates extensive self-test features which enhance system integrity by limiting undetected failures. When a detected failure renders one channel of the FADEC incapable of continued thrust management it will switch to the other channel. Table 004 summarizes the various types of hardware used in the FADEC and the hardware/software tests used to verifiy correct operation.

The outputs of these self-test routines are used in an extensive network of fault detection/accommodation logic. The logic was written to ensure that the engine control system is kept running whenever the capability is available. To accomplish this, the two channel electronic control will synthesize inputs from other available inputs, use data from the other channel, use available data to detect and accommodate soft (in range) failures of input parameters, and have the capability to tolerate and accommodate intermittent failures. The use of this advanced fault tolerant logic results in a system that can tolerate any single reasonable probability failure, within the FADEC (and sometimes two, three, or more) and keep running. Table 005 illustrates the fault logic hierarchy.

(b) Fail-safe capability

In the unlikely event of loss of both channels of the electronic control or loss of electrical power, hydraulic pressure or pneumatic pressure, the system is designed to go to the fail-safe positions indicated in Table 006.

ITEM CHECKED	CHECKED BY
Hardware - Input transducers, harnesses, signal conditioning interfaces	Software - Input range and rate limit tests - Input channel to channel comparisons, comparison to synthesized input
Hardware - A/D converter	Software - Reference Voltage test
Hardware/Software - Read Only Memory	Software/Hardware - Sum check - Memory parity check
Hardware - Random Access Memory	Software - Read/Write Test
Hardware - Processor	Software - Test instructions/computation - Watch dog timer
Hardware - Discrete output drivers - D/A converters, T/M driver, harnesses	Software - "Wrap-around" test - Checks for lack of response to processor request
Hardware - Power supply	Software - Supplies checked against referenced voltages
Hardware/Software - Cycle time	Hardware - Watch dog timer
Hardware/Software - Serial data channels	Hardware - Invalid data/lack of transmission test - "Wrap-around" test
Hardware - Clock/timing chain	Hardware - "Clock watcher"
Hardware - Frequency inputs	Software - Frequency I/F "wrap-around" tests
Hardware - Resolver inputs	Software - Sin2 plus Cos2 tests - Input range and limit rates - Channel to channel comparison

FADEC Hardware Self-Test
Table 004

FAULT	ACTION
1. Loss of redundant input (N1, N2, Pamb, PB, P2, P5, T2, T3,TLA, actuator feedbacks, discretes, serial inputs)	Use other channels input via crosstalk data link
2. Loss of output driver for any device with redundant actuator coils	Switch channel if opposite channel is more capable
3. Common input faults to both channels	
- T2 sensor failure	Revert to alternate mode (N1) - Select left ADC if "healthy" - Select right ADC if "healthy" and left is not - Hold past value if both ADCs not "healthy"
- Data entry plug	Revert to alternate mode (N1) upon initialization
- Pamb sensor or sense line failure	Both ADC's "healthy" and ADCs agree with each other - Compares with synthesis, use LADC - Disagrees with synthesis, use synthesis (N1) Both ADC's "healthy" and disagree with each other (N1) - Use ADC value which compares with synthesis - If neither compare with synthesis, use synthesis One ADC "healthy" (N1) - Select ADC if compares with synthesis - Select synthesis if ADC disagrees with synthesis Neither ADC "healthy" (N1) - Select synthesis if healthy - Select failsafe if synthesis failed
- P2 sensor or sense line failure	Revert to alternate mode (N1), compare ADC's to synthesis - ADC compare with each other . Use LADC if compare with synthesis . Use synthesis if disagree - ADC disagree with each other . Use ADC which compares . Use synthesis if neither agrees with synthesis
- P5 sensor or sense line failure	Revert to alternate mode (N1) and synthesize P5 from N1C2, MN, P2
- Pb sensor failure	Synthesize Pb from N2C2

FAULT	ACTION
- N1 sensors dual failure	Synthesize N1 from N2C2, MN
- N2 sensor dual failure	Synthesize N2 from N1C2, MN
- TLA input dual failure	Revert to fixed thrust lever setting giving Idle EPR or 1.000 whichever is greater
4. Loss of Channel Capability (i.e., loss of power, CPU, memory, etc.)	Automatic switchover to other channel
5. Channel lost or not enough parameters available to run engine control loops	Failsafe affected loops for loss of loop capability. Failsafe all loops for loss of channel capability

Fault Logic Hierarchy
Table 005

DEVICE	ELECTRICAL FAILURE TORQUE (T/M) / SOLENOID (S)	LOSS OF HYDRAULIC (H) / PNEUMATIC (P) PRESSURE
Engine Air/Oil Heat Exchanger Valve	Full Open (T/M)	N/A
Variable Stator Vane Actuator	Full Open (T/M)	N/A
2.5 Bleed Valve Actuator	Full Open (T/M)	N/A
Turbine Case Cooling Air Shutoff Valve	Closed (T/M)	N/A
Fuel/Oil Cooler Bypass Valve	Not Bypassed (S)	N/A
Fuel Metering Unit Fuel Metering Valve	Minimum Fuel Flow Stop (T/M)	N/A
Turbine Vane and Blade Cooling Air Valves	Full Open (S)	Full Open (P)
Thermatic Rotor Control/Thrust Balance Vent Valves (Left and Right)	9th Stage Air Flow (S)	9th Stage Air Flow (P)
IDG Air/Oil Heat Exchanger Valve	Full Open (S)	Full Open (P) (H)
2.9 Bleed Valve (Right) (Compressor Stability Bleed # 2)	Full Open (S)	Full Open (P)
2.9 Bleed Valve (Left) (Compressor Stability Bleed # 1)	Closed (S)	Full Open (P)

System Fail-Safe Conditions
Table 006

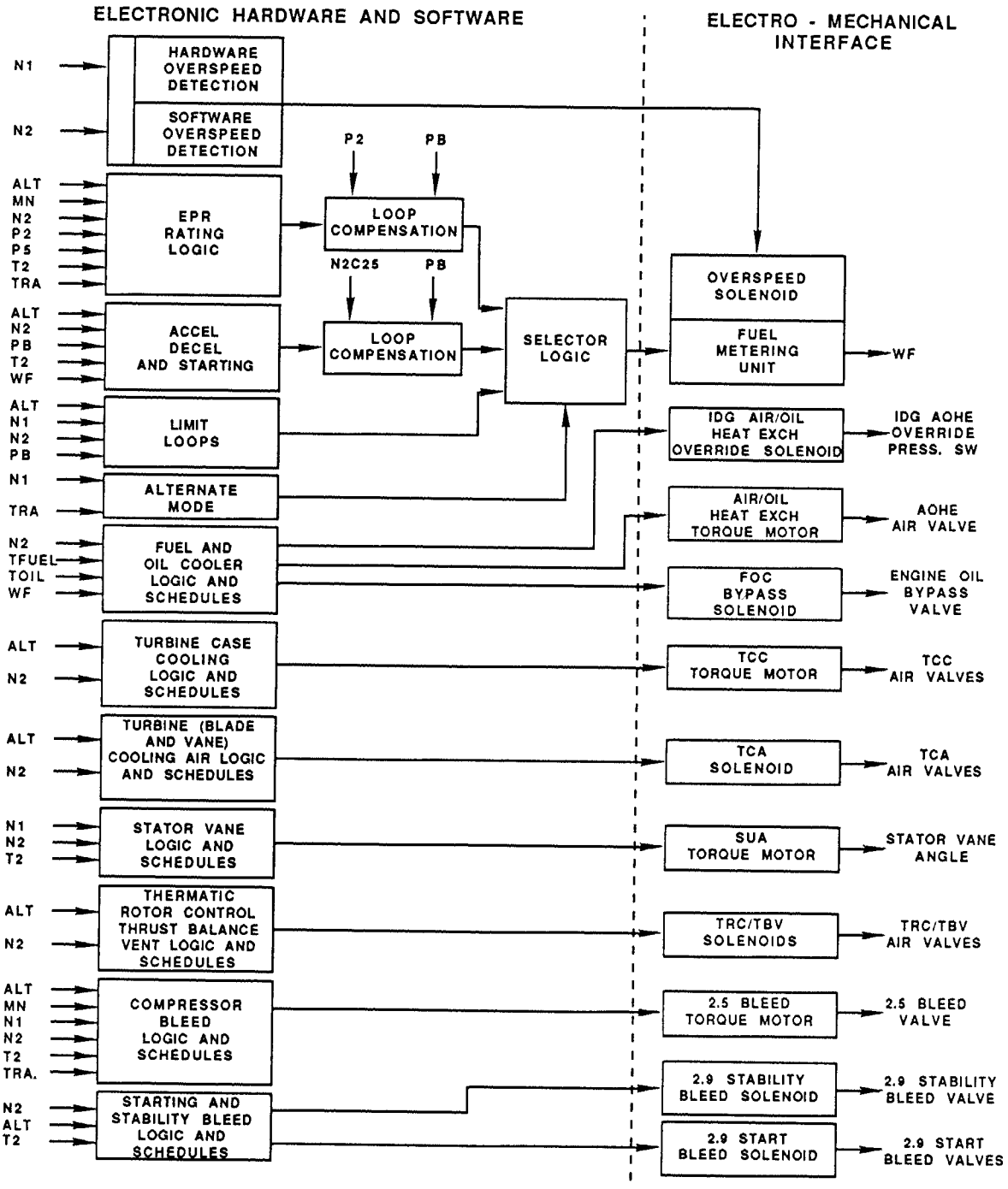
**ON A/C 101-105,

Post SB 71-2024 For A/C 101-105,

DEVICE	ELECTRICAL FAILURE TORQUE (T/M) / SOLENOID (S)	LOSS OF HYDRAULIC (H) / PNEUMATIC (P) PRESSURE
Engine Air/Oil Heat Exchanger Valve	Full Open (T/M)	N/A
Variable Stator Vane Actuator	Full Open (T/M)	N/A
2.5 Bleed Valve Actuator	Full Open (T/M)	N/A
Turbine Case Cooling Air Shutoff Valve	Closed (T/M)	N/A
Fuel/Oil Cooler Bypass Valve	Not Bypassed (S)	N/A
Fuel Metering Unit Fuel Metering Valve	Minimum Fuel Flow Stop (T/M)	N/A
Turbine Vane and Blade Cooling Air Valves	Full Open (S)	Full Open (P)
IDG Air/Oil Heat Exchanger Valve	Full Open (S)	Full Open (P) (H)
2.9 Bleed Valve (Right) (Compressor Stability Bleed # 2)	Full Open (S)	Full Open (P)
2.9 Bleed Valve (Left) (Compressor Stability Bleed # 1)	Closed (S)	Full Open (P)

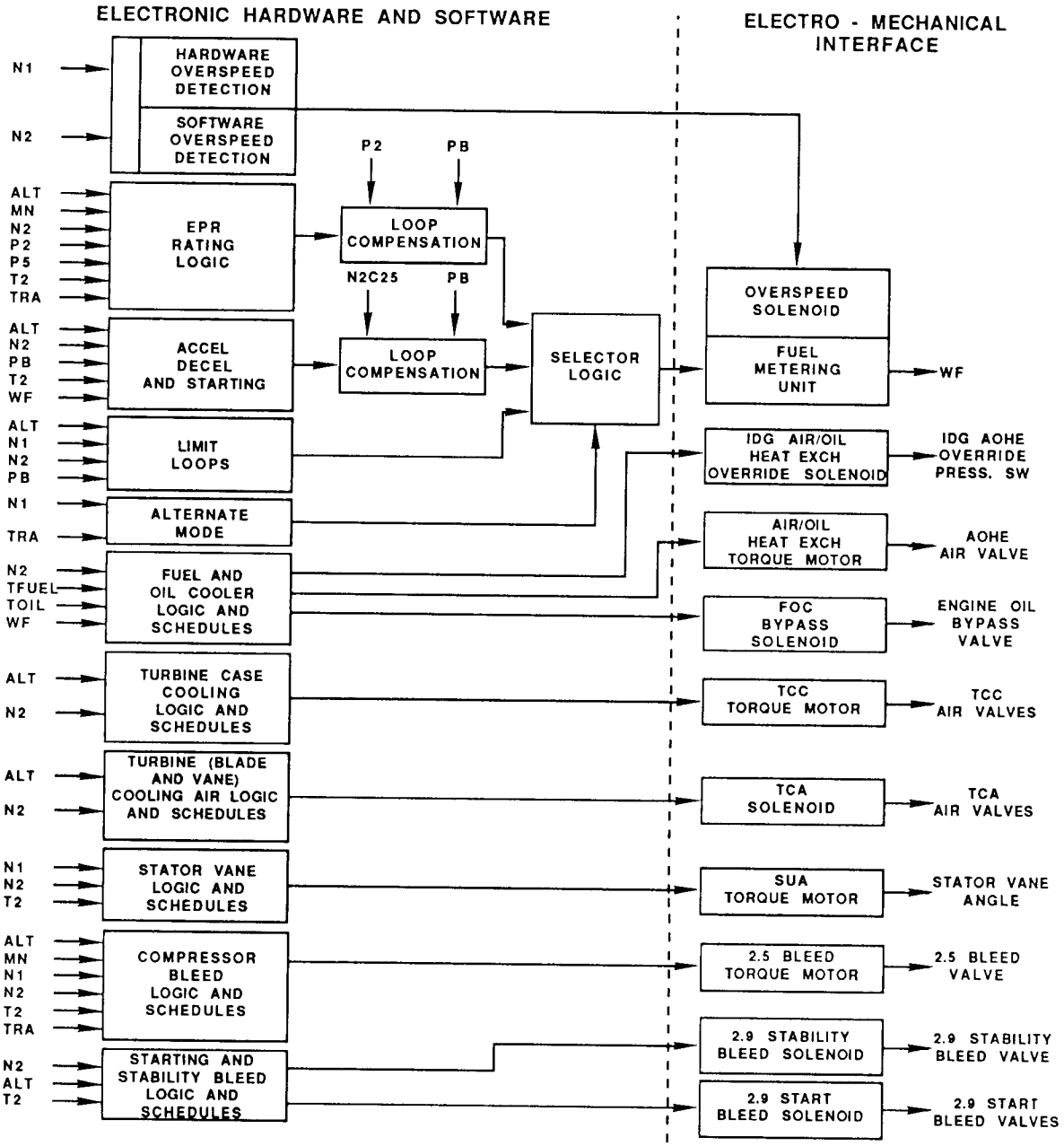
System Fail-Safe Conditions
Table 006

**ON A/C 101-200,



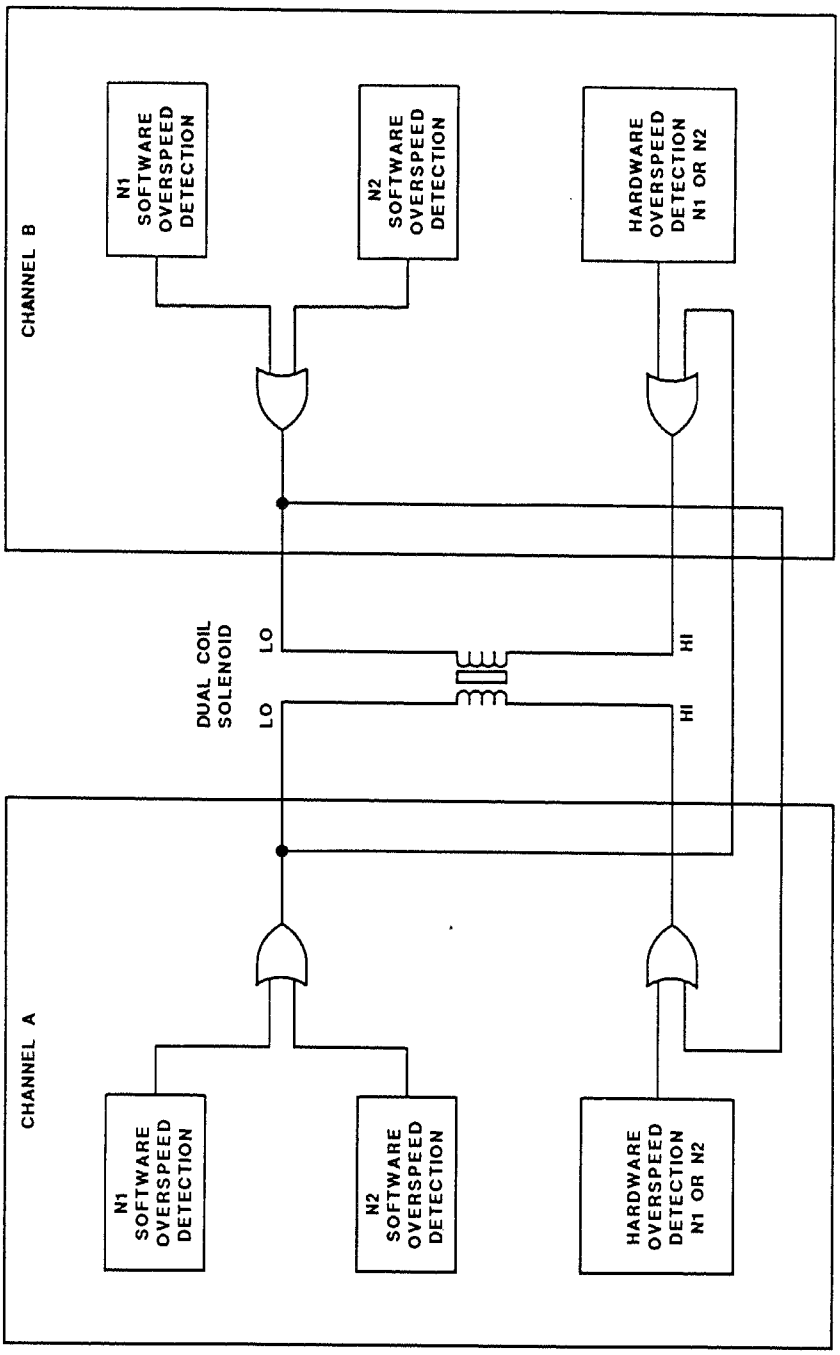
BM5 73 25 00 0 KNMO - 23

Control Mode Simplified Block Diagram
Figure 028



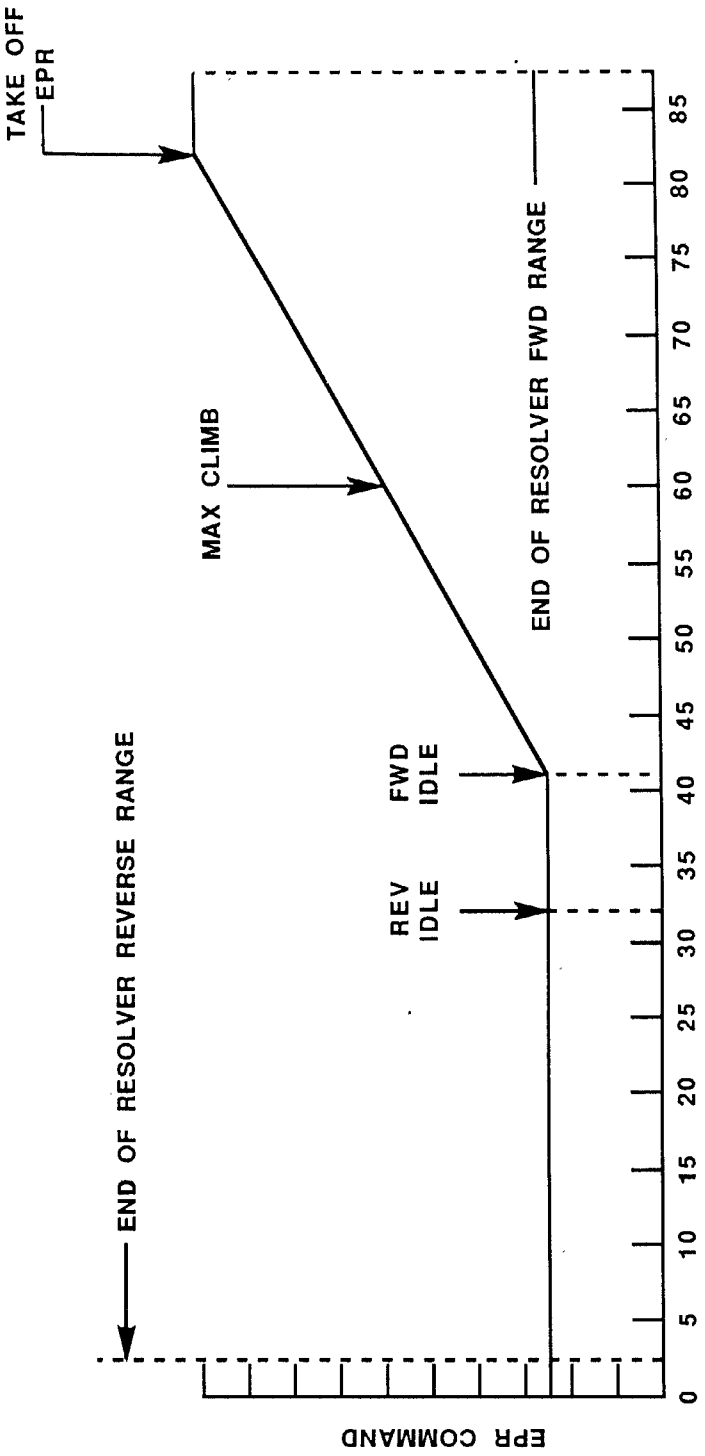
BM5 73 25 00 0 KNT0 00

Control Mode Simplified Block Diagram
Figure 029



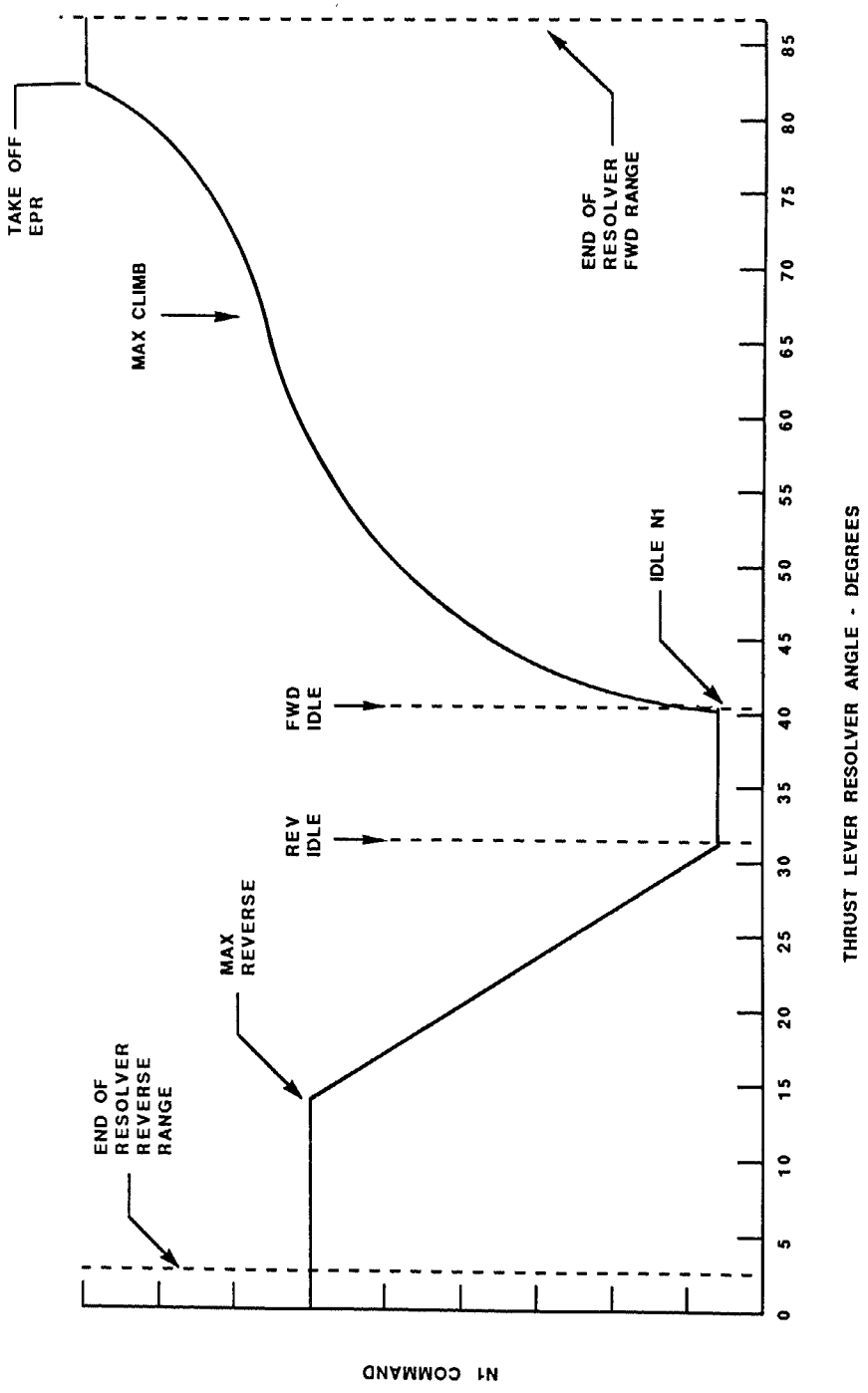
BM5 73 25 00 0 KPMO · 20

Overspeed System Schematic
Figure 030



BM5 73 25 00 0 KRMO - 20

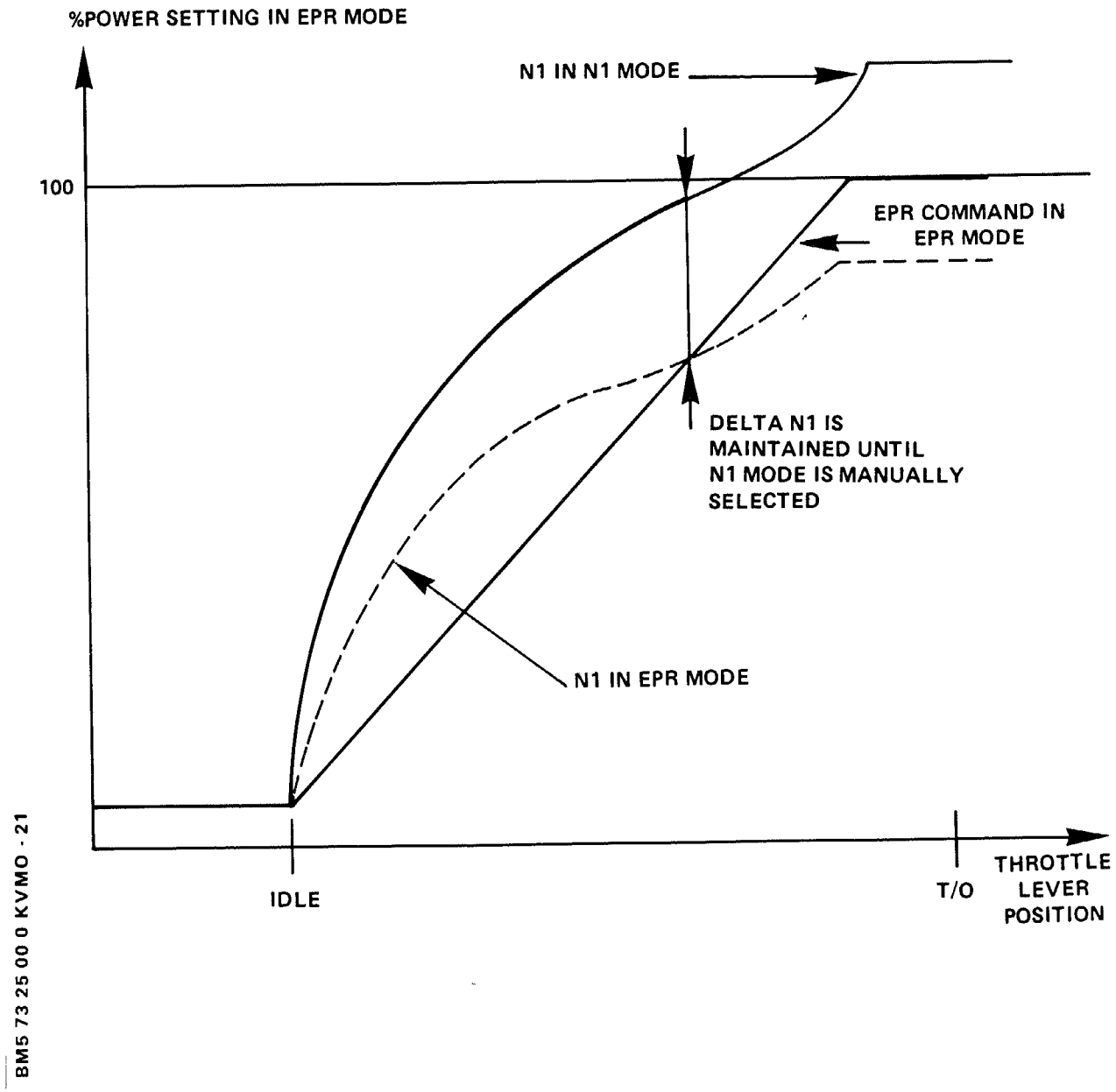
Typical EPR Command VS. TRA
Figure 031



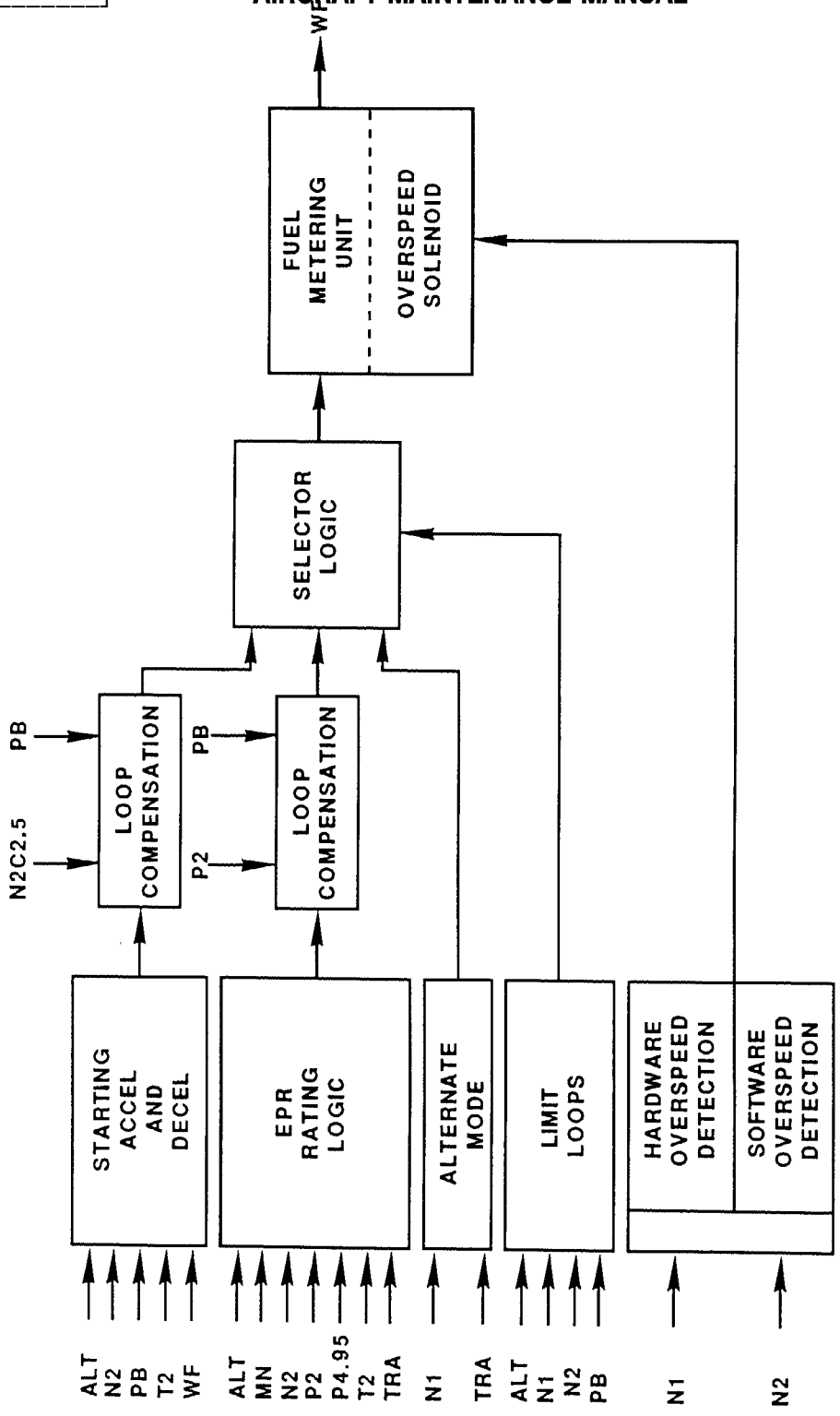
BM5 73 25 00 0 KTMO - 20

Typical N1 Command VS. TRA
Figure 032

STEADY STATE CONTROL

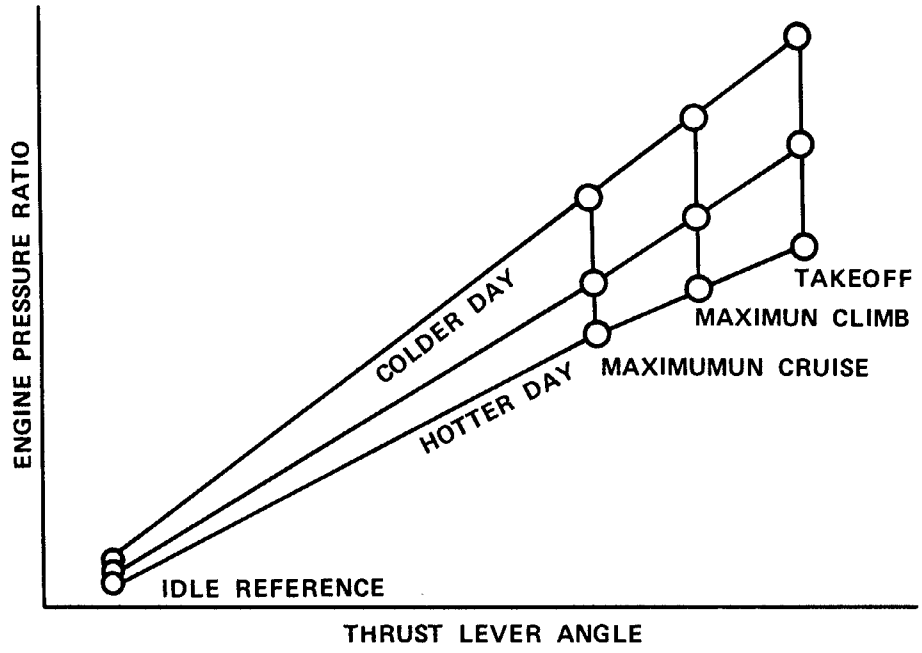

%POWER SETTING IN EPR MODE
N1 IN N1 MODE
100
EPR COMMAND IN EPR MODE
DELTA N1 IS MAINTAINED UNTIL N1 MODE IS MANUALLY SELECTED
N1 IN EPR MODE
IDLE
T/O
THROTTLE LEVER POSITION
BM5 73 25 00 0 KVMO - 21

Mode Switching
Figure 033



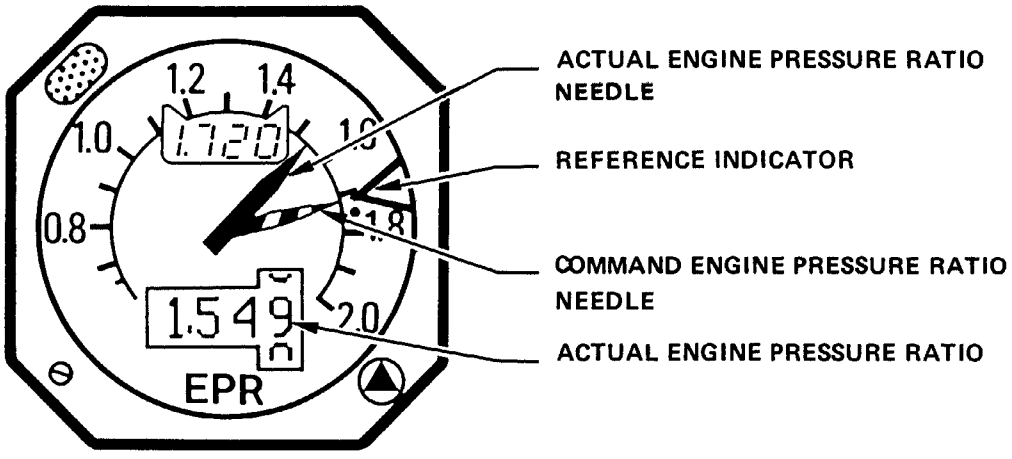
BM5 73 25 00 0 KXMO - 19

Thrust Management and Rating Control
Figure 034



THRUST LEVER CONTROL OF ENGINE PRESSURE RATIO

ENGINE PRESSURE RATIO GAUGE



BM5 73 25 00 0 KZMO-19

Engine Pressure Ratio Indicator
Figure 035

2. FADEC System Interface with Airframe

A. System Configuration (Ref. Fig. 036, 037)

The FADEC unit interfaces with the following aircraft functional elements :

(1) Throttle control system : translates the crew commands for engine power level into a command signal to the FADEC system.

(2) Air Data Computers (ADC) : Transmit air data signals to the engine control system.

(3) Thrust Control Computers (TCC) : computes EPR limit as a function of selected mode and environmental conditions, and also converts airframe discrete signals required by the engine controls to serial digital data.

(4) Electrical power : provides electrical system power for the engine performance solenoids and PT2/TT2 probe heater which require more power than the FADEC dedicated power source can supply. The electrical power system is also used to power the FADEC during the ground test when the engines are not running, and in case of PMA failure when the engines are running.

(5) The Generator Control Unit (GCU) : controls IDG functions including the IDG air/oil cooler operation. The FADEC overrides the GCU control to open the IDG air/oil cooler valve in case of low speed or high engine oil temperature.

(6) Flight Compartment displays (indicators and ECAM) : take the outputs of each channel serial digital output bus or dedicated hardware link and display appropriate engine parameters and condition data in the flight compartment. Output buses are also received by the aircraft equipment used to record or display engine data for maintenance purposes.

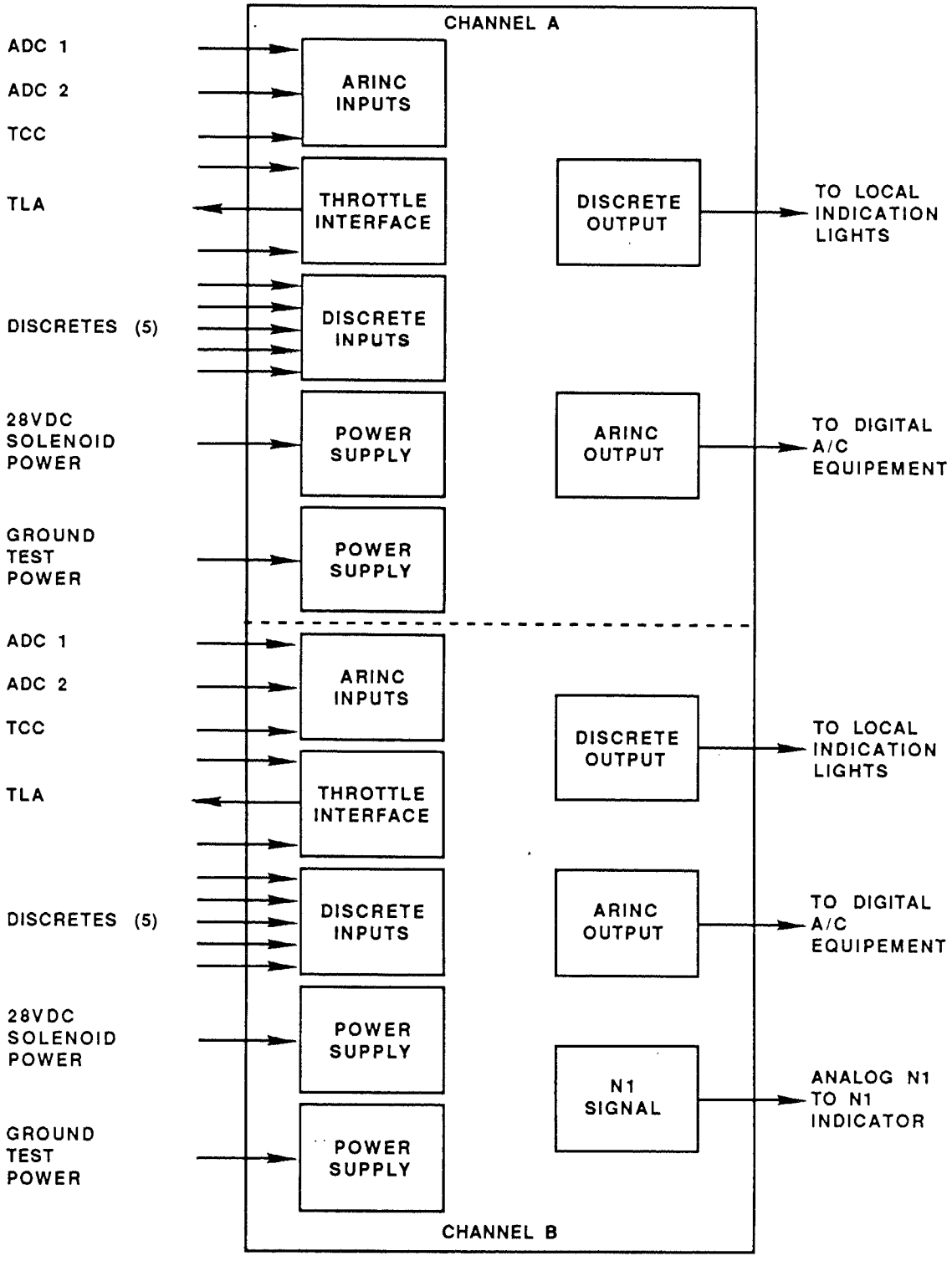
(7) Switches : provide the FADEC with analog control discretes. The FADEC provides the aircraft with output discretes used to illuminate local annunciator lights.

The interface includes the connecting wiring between the above elements and the two FADEC channels, suitable separated for redundancy and protected from electromagnetic interference and effects of lightning strike.

Remarks :

1 - Fuel and ignition controls, which allow engine starting and shutdown in conjonction with the FADEC system, are totally independent of the FADEC.
The HP fuel valve interfaces directly with the fuel metering unit.

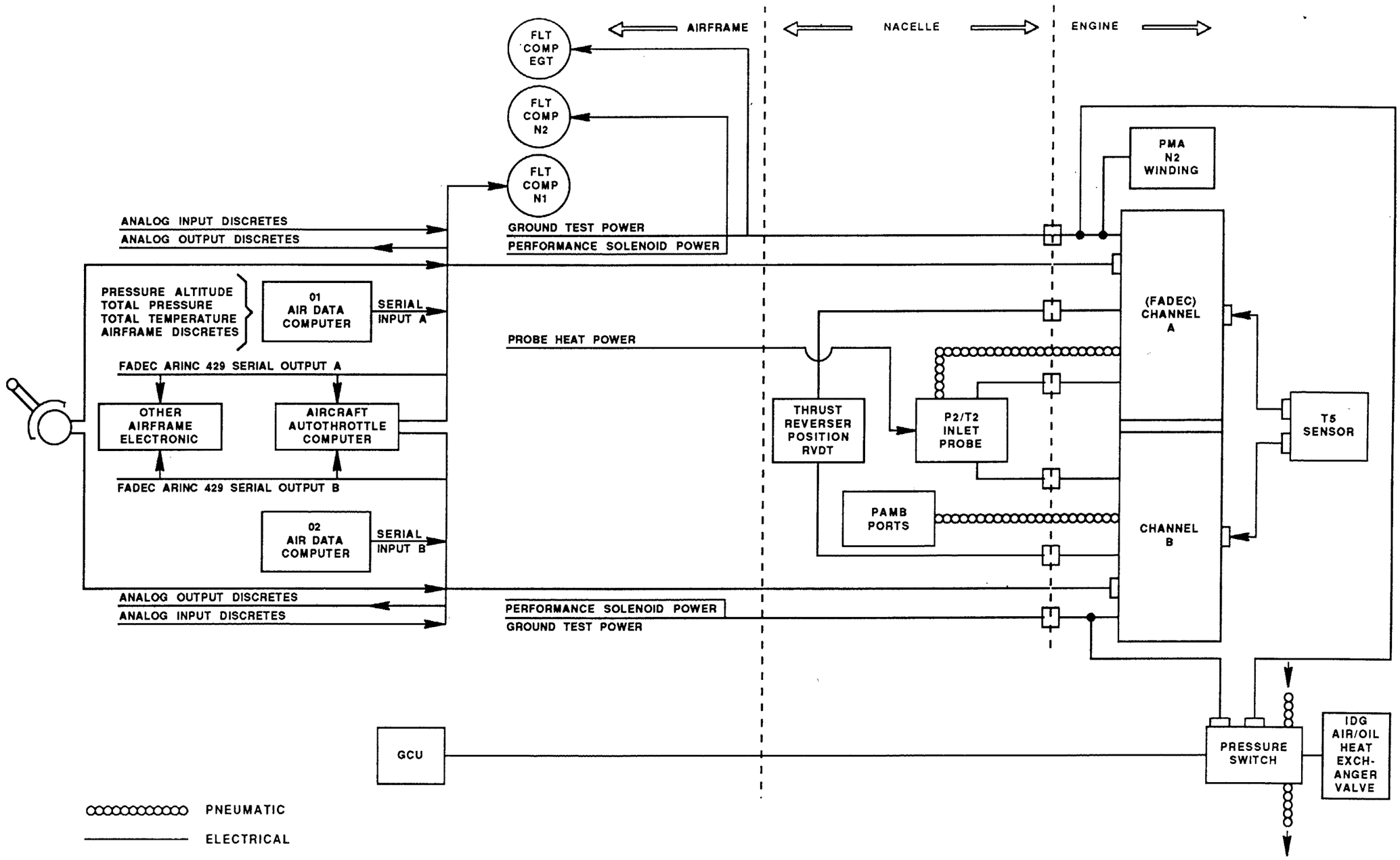
2 - The FADEC system is able to accomplish all its functions without any airframe data (digital or analog signals, power supply) with the exception of the throttle control lever position necessary to modulate thrust.



BM5 73 25 00 0 KBNO - 20

FADEC Unit Interface With Airframe
Figure 036

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FADEC System Interface With Airframe
Figure 037

B. Throttle Control System Interface

(1)General (Ref. Fig. 038)

The throttle control system is fully electrical.

Each throttle control lever drives a resolver unit, located in the center pedestal. This resolver unit includes three resolvers : two resolvers are dedicated to the FADEC (1 to each channel) and the third one to the thrust control computer (Ref. 76-00-00).

The FADEC excites and senses the feedback position from these resolvers. It choose permanently a healthy input and accommodates failures on this interface.

(2)Relationship and critical points (Ref. Fig. 039, 040, 041)

The throttle control levers move over a range of 55° TLA between two physical stops :

- The full forward stop (55° TLA) which corresponds to the Max. Take-off/Go-around thrust rating.
- The full rearward stop (0° TLA) which corresponds to the Idle setting.

A unique intermediate constant position corresponds to the Max. Climb rating, when in primary control mode.

In addition, when throttle control levers are in idle stop position, action on the thrust reverser control levers is possible to command the thrust reverser operation and the corresponding thrust application.

A "Hard Point" is incorporated into the throttle linkage to indicate to the crew, through the thrust reverser control lever, the limit of the idle flat reverser deploy region. From this point if the lever is pulled reverse thrust is applied, if the lever is pushed the reverser is stowed.

The rigging point for the "Hard Point" is between the deploy selection and the idle flat region.

Max. Reverse thrust setting is obtained at full rearward thrust reverser control lever position.

(3)Command selection and thrust adjustment

The throttle control lever is used as a rating setting device. By receiving the throttle control lever position signal, the FADEC, which computes thrust limit ratings (in the FADEC Primary Mode), selects the corresponding command value and sends it to the flight compartment.

The actual thrust level controlled by the FADEC is adjusted to the level required by the throttle control lever position.

(4)Resolver input selection logic

The two resolver values are exchanged between both channels through cross-talk. After validation in each channel (range and rate tests), the FADEC selects the best value, based on the objective to keep the engine operational as long as possible.

The selection logic depends on the health of each channel interface. The accommodation strategy is as follows :

(a)Two validated resolvers

Both resolvers not hardfailed, within range and rate limits and in agreement within 1.5° of each other. The FADEC selects the local resolver (from the controlling channel).

(b)Loss of one resolver

If one resolver should fail for any reason, the resolver will be excluded from the selection algorithm. The failure will be accommodated

by utilizing the crosstalked TRA value from the other channel. A maintenance word flag will be set.

(c)Two resolvers which disagree :

In case of identified tracking error between two validated resolver signals (difference greater than 1.5°) the accommodation will be as follows :

- On ground, the FADEC will select the failsafe TRA (idle)
- In flight, the FADEC will select the larger value of TRA. In case the range limit is exceeded by one resolver, this resolver will be excluded from the selection logic and the FADEC will use the remaining signal.

The failure will be indicated in status and maintenance words.

(d)Non validated resolvers :

The case where both resolvers are not valid (both hard failed or failed during the validation tests) and are excluded from the selection algorithm is accommodated as follows :

- On ground, the FADEC will use failsafe TRA (idle).
- In-flight, the FADEC will select the last healthy value.

After the above accommodation, if a reset occurs causing an initialization and the fault is still present, the FADEC will select the failsafe TRA for the aircraft configuration (whether on ground or in flight).

The failure will be indicated in status and maintenance words.

(e)Ground/flight selection :

The determination of "on ground" or "in-flight" as specified in the TRA selection logic is based upon Weight On Wheels (TCC ARINC 429, label 273 bit 22) and Mach number. The following rules will be used in the determination of flight/ground operation :

1 Normal case : After reception and validation of the TCC label 273
Ground : wow indicates on ground (bit set).
In flight : wow indicates in flight (bit cleared).

2 Failure accommodation : In case of no reception or no validation of the TCC label 273, the FADEC will apply the following accommodation for resolver input faults :
- for Mn less than 0.35, the accommodation will be as on ground,
- for Mn greater than 0.35, the accommodation will be as in flight.

(f)Indication :

Following the accommodation, an appropriate message will be given to the crew when the engine behaviour is affected. Theses messages are based on discrete words sent by the FADEC.

(5)Throttle control lever position modulation as a function of reverser position

(a)General (Ref. Fig. 042, 043)

The FADEC interfaces with the thrust reverser system to provide thrust limiting during any reverser transition. It monitors reverser position and throttle control setting. It maintains engine power setting at idle as long as the reverser is in transition or in case of inadvertent deployment or stow. The idle power setting is accomplished via a multiplier function applied to the FADEC selected TRA value. The multiplier is a function of the TRA input and reverser position (Ref. Fig. 043).

In normal reverser deploy operation with TRA in the reverse region, the FADEC restricts engine power to idle while the reverser travels from the stowed position to a position beyond the null thrust point. From this point the FADEC allows, via the multiplier, a progressive increase in engine power. Once the reverser is 90 % or more deployed, the FADEC schedules power in accordance with the reverse region TRA setting ; that is, the multiplier on the TRA is equal to one.
In normal reverser stow operation, the FADEC restricts engine power to idle while the reverser travels from the deployed position to a position less than the null thrust point. From this point the FADEC allows, via the multilplier, a progressive increase in engine power if the TRA is in the forward region. Once the reverser is less than 10 % deployed, the FADEC will schedule forward power setting in accordance with the TRA setting.
The FADEC retards engine power toward idle if the reverser departs by 10 % or more, the normal position as determined by the TRA input to the FADEC. The FADEC reduces the power to idle prior to the reverser reaching the null thrust position. The power will be restricted to idle with continued travel of the reverser toward the non-commanded position.
In the case of inadvertent deployment, TRA indicating forward throttle setting and reverser not stowed, the engine power setting is maintained at idle.
The control of the reverser stow and deploy actuators is provided by the aircraft and is totally independent of the FADEC as well as the reverser annunciator light logic.

(b)Thrust reverser position detector

The FADEC receives the electrical position of the reverser sleeves from rotary variable differential transformers.
The integrity of these inputs is checked as follows :

1 Range test

A reverser input is considered faulty if it exceeds :
Max in-range position = 106 % Deployed
Min in-range position = -4 % Deployed

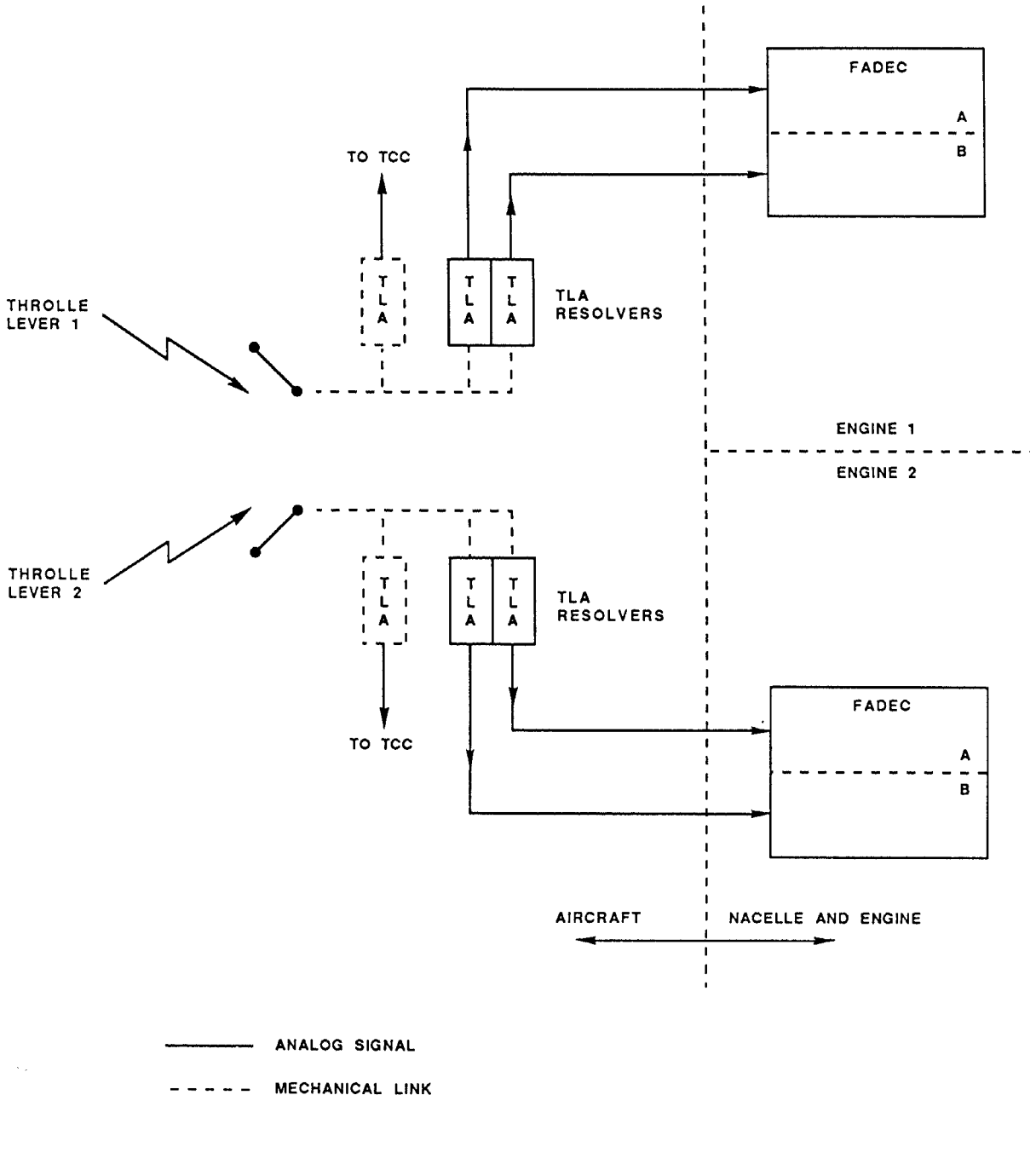
2 Crosscheck test

Each channel compares the reverser position input it receives with the position the other channel receives, and it transmits by crosstalk. The allowable difference is 5 % of position. If this difference is exceeded, the faulty signal is isolated by voting based on TRA position.
Intermittent faults of the reverser position inputs are latched by using the fault latching technique.

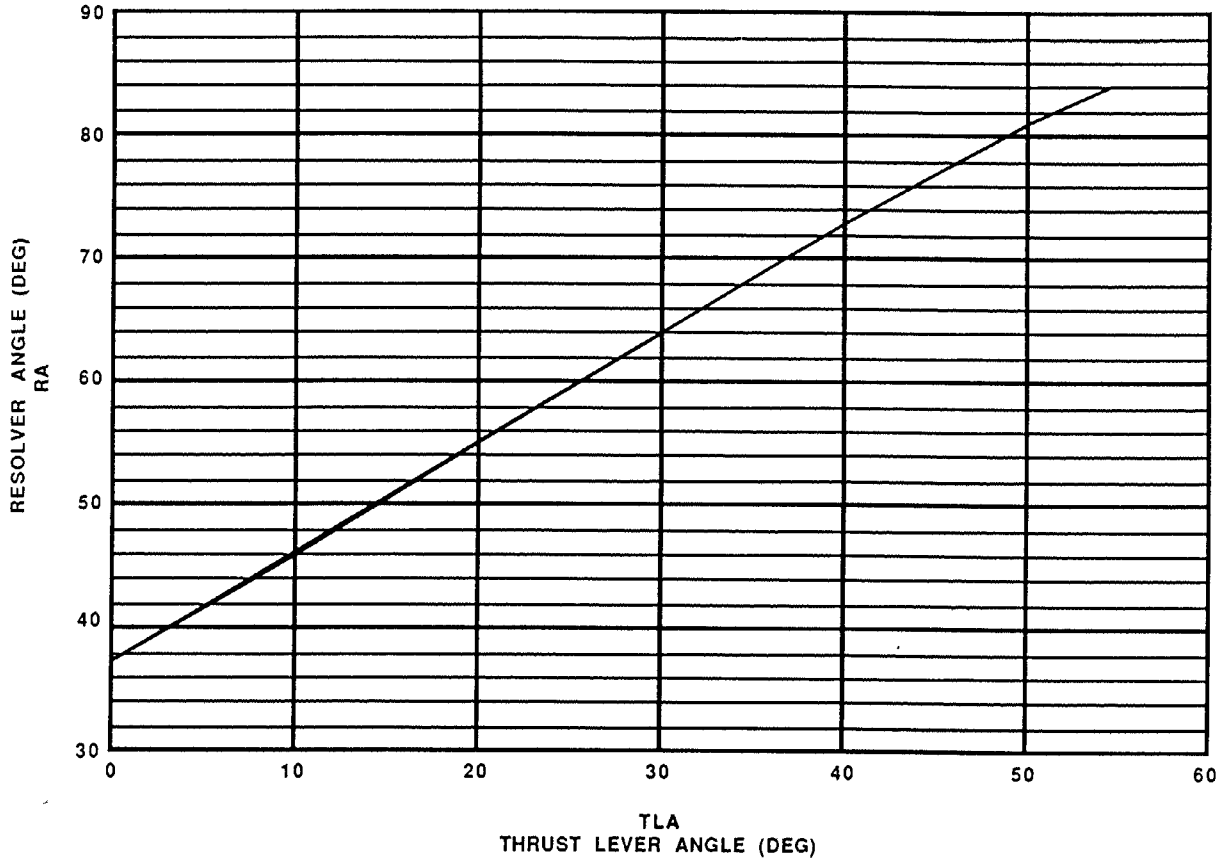
3 Failure accomodation

Thrust reverser position faults are accommodated as follows :
- Loss of the channel position input is accommodated by borrowing the other channel's input via the crosstalk data link.
- Loss of both position inputs is accommodated by assuming that the reverser is in the stowed position.
- If the local and cross-talked inputs disagree, neither input is range or rate failed and both interfaces are okay, a bit is set indicating a cross-check failure. If the cross-check failure bit

is set, the reverser position selected by the **FADEC** is the more stowed position.
This is the position which will provide the higher power setting if **TRA** indicates forward and lower power setting if **TRA** indicates reverse.

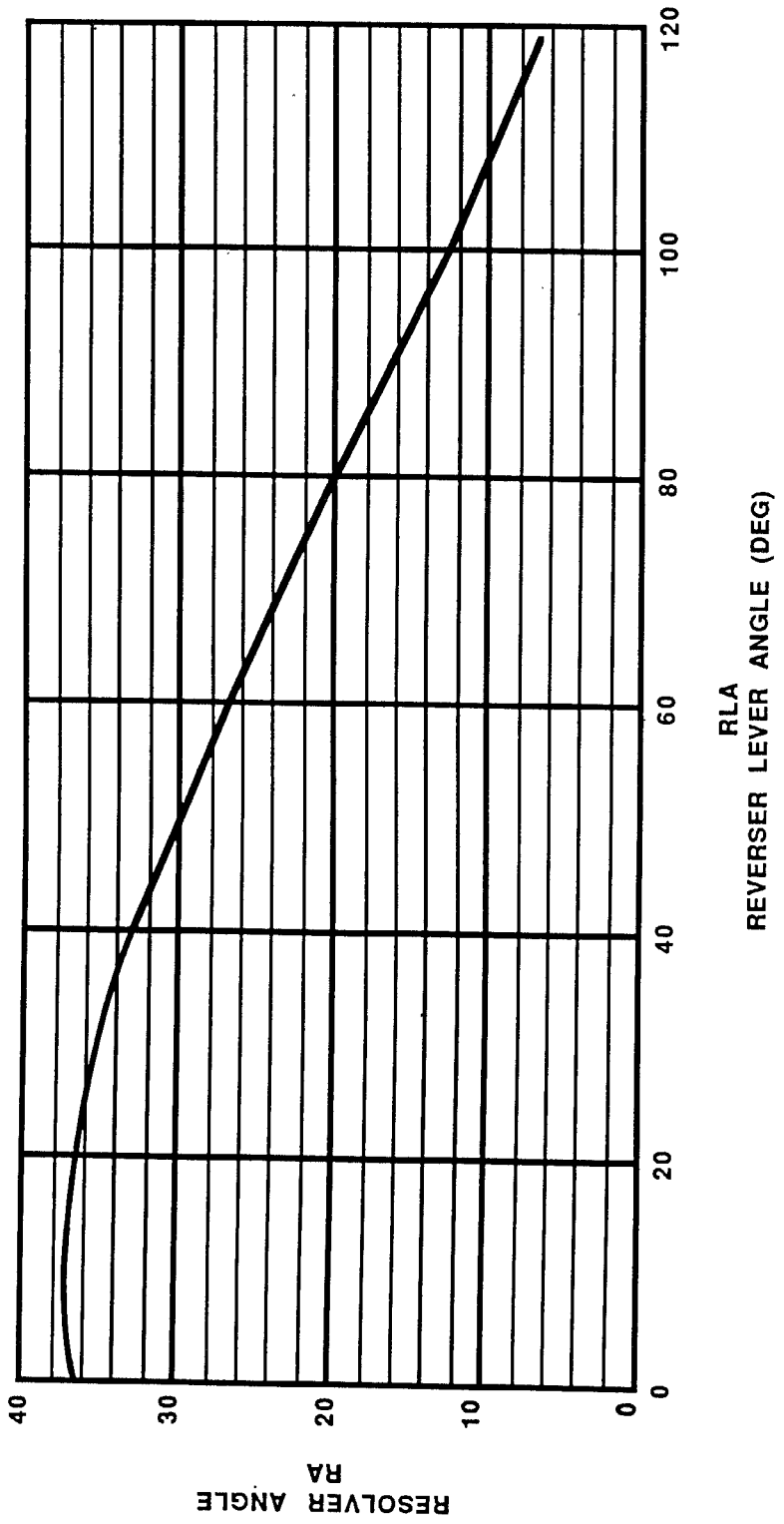


Throttle Control System Interface
Figure 038



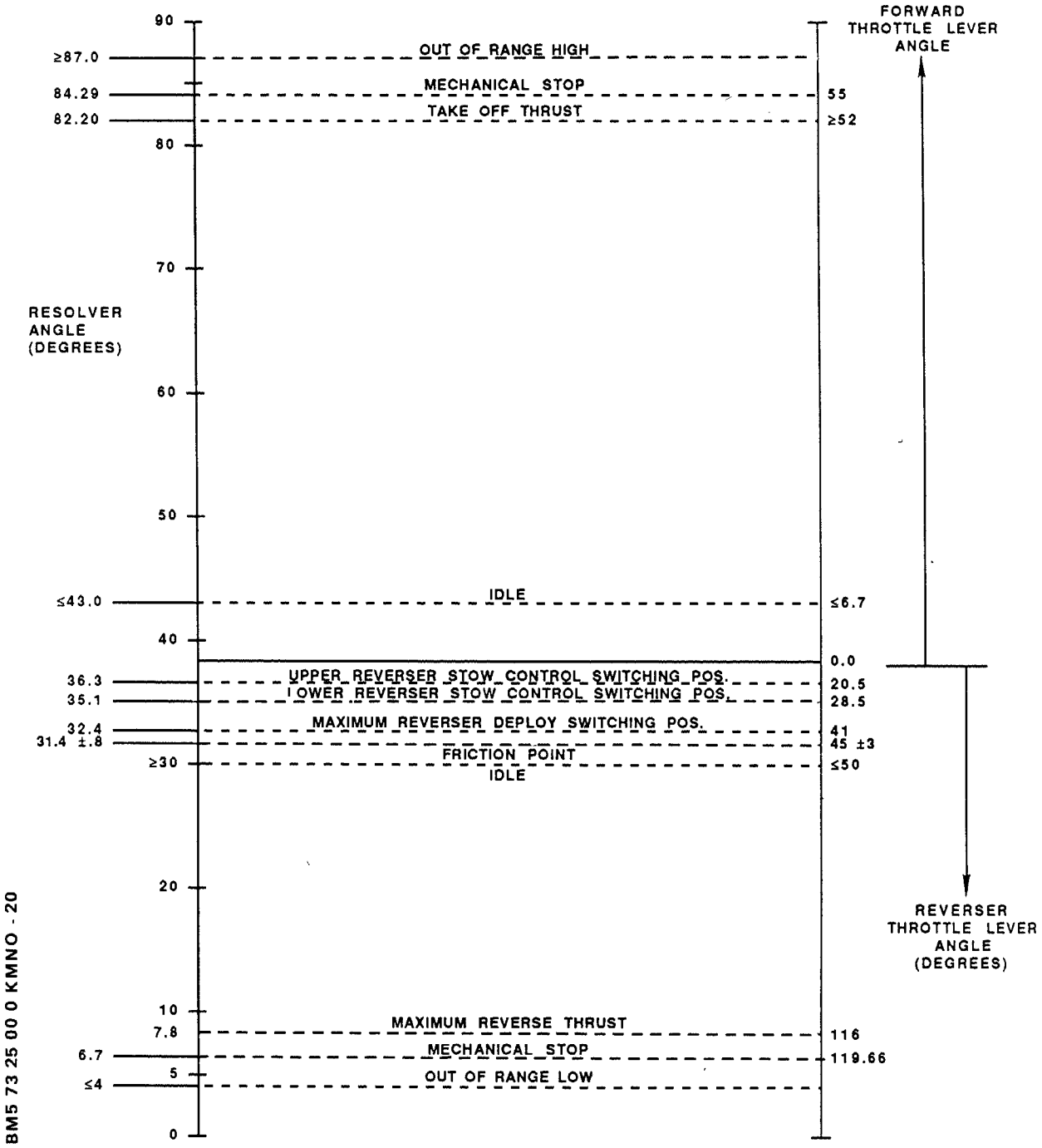
BM5 73 25 00 0 KHNO - 19

Resolver Angle VS. Thrust Lever Angle Typical Nominal Relationship
Figure 039

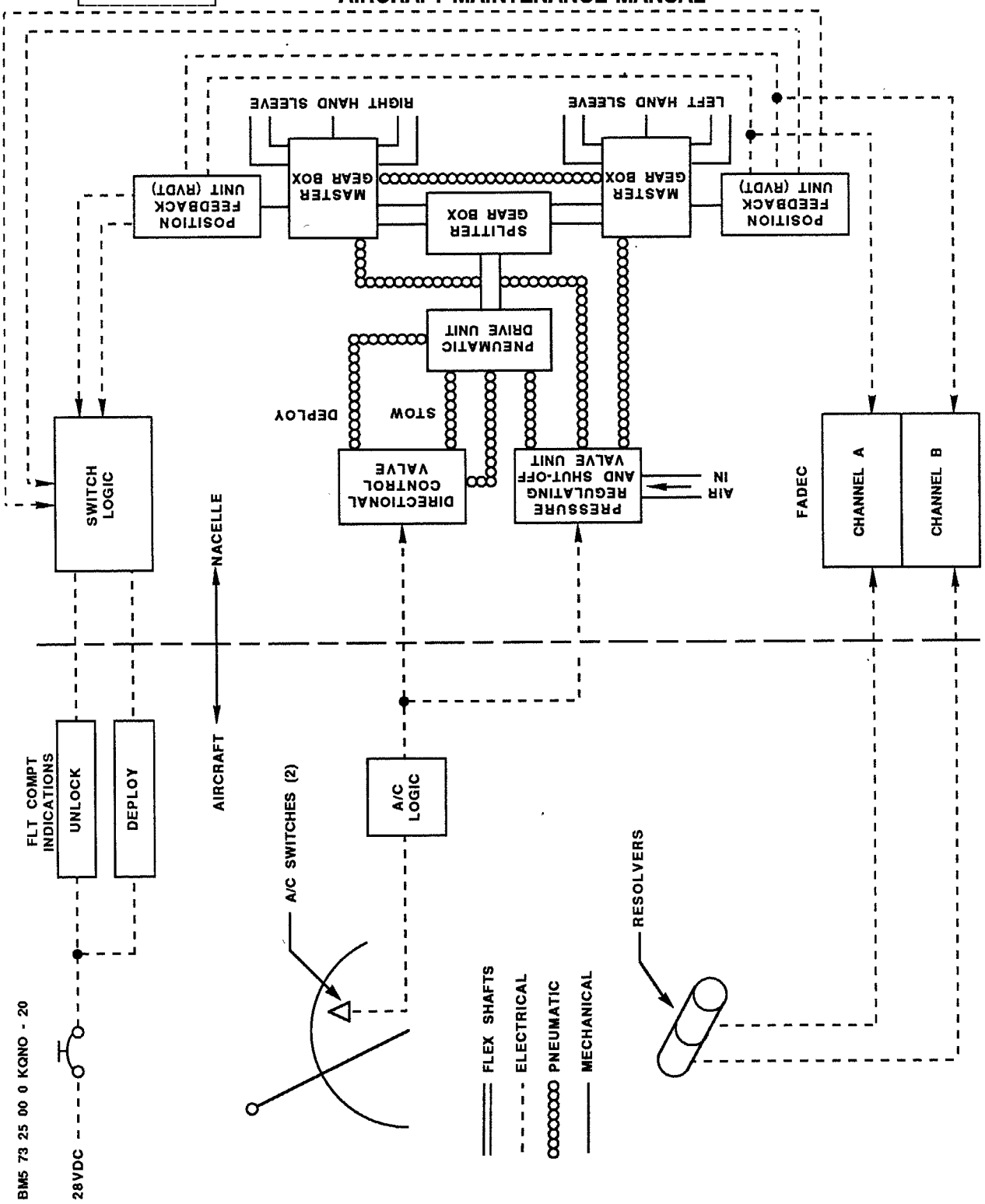


BMS 73 25 00 0 KKNO - 20

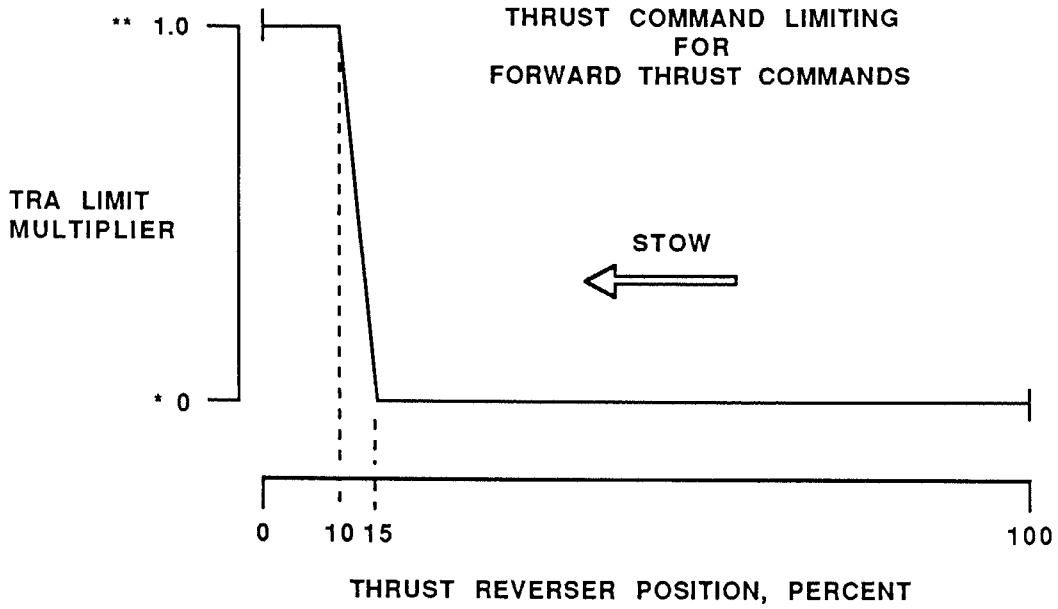
Resolver Angle VS. Reverser Lever Angle Typical Nominal Relationship
Figure 040

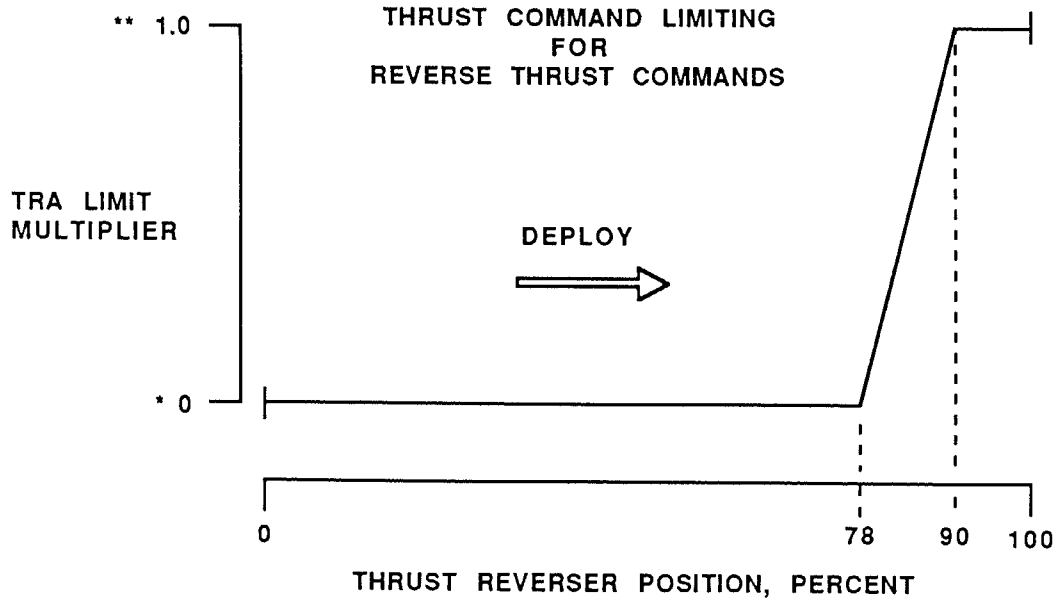


TLA/RLA VS. Resolver Angle Critical Points
Figure 041



FADEC Interface with Thrust Reverser System
Figure 042





** MULTIPLIER CORRESPONDING TO ACTUAL TRA POSITION.
* MULTIPLIER CORRESPONDING TO IDLE TRA POSITION.
TRA : THROTTLE RESOLVER ANGLE.

BM5 73 25 00 0 KSNO - 19

Thrust Levers Modulation as a Function of Reverser Position
Figure 043

C. Air Data Computers (ADC) Interface

(1)General (Ref. Fig. 044, 045, 046)

Each channel of the FADEC has input ports for two air data computer ARINC 429 data busses.

The two FADECs are dedicated to separate ADC output ports in order to isolate them. The crosswiring between the ADCs and the FADECs is shown in referenced figures.

The FADEC receives from the ADCs the following data (see Table 007 and 008)

- Pressure altitude,
- Total pressure,
- Total air temperature,
- ADC status word used in parameter validation logic.

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label		X
8	Label		X
9	SDI		
10	SDI		
11	Not used by FADEC	---	---
12	Total pressure probe heat	ON	OFF
13	Not used by FADEC	---	---
14	Left Static Probe Heat	ON	OFF
15	Right Static Source Heat	ON	OFF
16	Not used by FADEC	---	---
17	Not used by FADEC	---	---
18	Not used by FADEC	---	---
19	Not used by FADEC	---	---
20	Not used by FADEC	---	---
21	Not used by FADEC	---	---
22	Not used by FADEC	---	---
23	Not used by FADEC	---	---
24	Not used by FADEC	---	---
25	Not used by FADEC	---	---
26	Not used by FADEC	---	---
27	Not used by FADEC	---	---
28	Not used by FADEC	---	---
29	Not used by FADEC	---	---
30	SSM		
31	SSM		
32	Parity (ODD)		

ADC Status Word No. 1 Label 270
Table 007

Each port looks for the following data :

PARAMETER	PRESSURE ALTITUDE	TOTAL PRESSURE	TOTAL AIR TEMPERATURE
Octal label	203	242	211
Signal Format	BNR	BNR	BNR
Units	Feet	mb	°C
Range	131,072	2048	512
Parameter range	-1000 to 50,000	135.5 to 1354.5	-60 to 99
Significant bits*	17	16	15
Approximate resolution	1.0	0.03125	0.015625
Accuracy (Note 2)	Note 1	± 1.02	± .5
Maximum transmit interval (msec)	62.0	125	500
Transport delay (msec)	145/1 Hz	160/1 Hz	500/1 Hz

* Not including sign.

Note 1 : ± 15 feet from -1000 to sea level
± 20 feet at 10,000 ft
± 40 feet at 30,000 ft
± 80 feet at 50,000 ft

Intermediate range accuracies are defined by straight lines connecting the above points.

ADC Parametric Data to FADEC
Table 008

(2)Selection logic

Each **FADEC** channel receives a digital data stream from both air data computers which contains total temperature, total pressure, and altitude signals from the airframe. In addition the **FADEC** has dedicated sensors to provide the capability to detect, isolate, and accommodate failures of these signals. The **FADEC** sensor complement for these signals is comprised of dual element total temperature probe (one element per channel), a dual element **T3** probe, used to synthesize **T2** (one element per channel), a dedicated total pressure probe (hardwired to each channel), and a dedicated ambient pressure ports (plumbed to the **FADEC** sensor which is hardwired to each channel).

Software selection logic is used to determine what source of each parameter should be used, after validation.

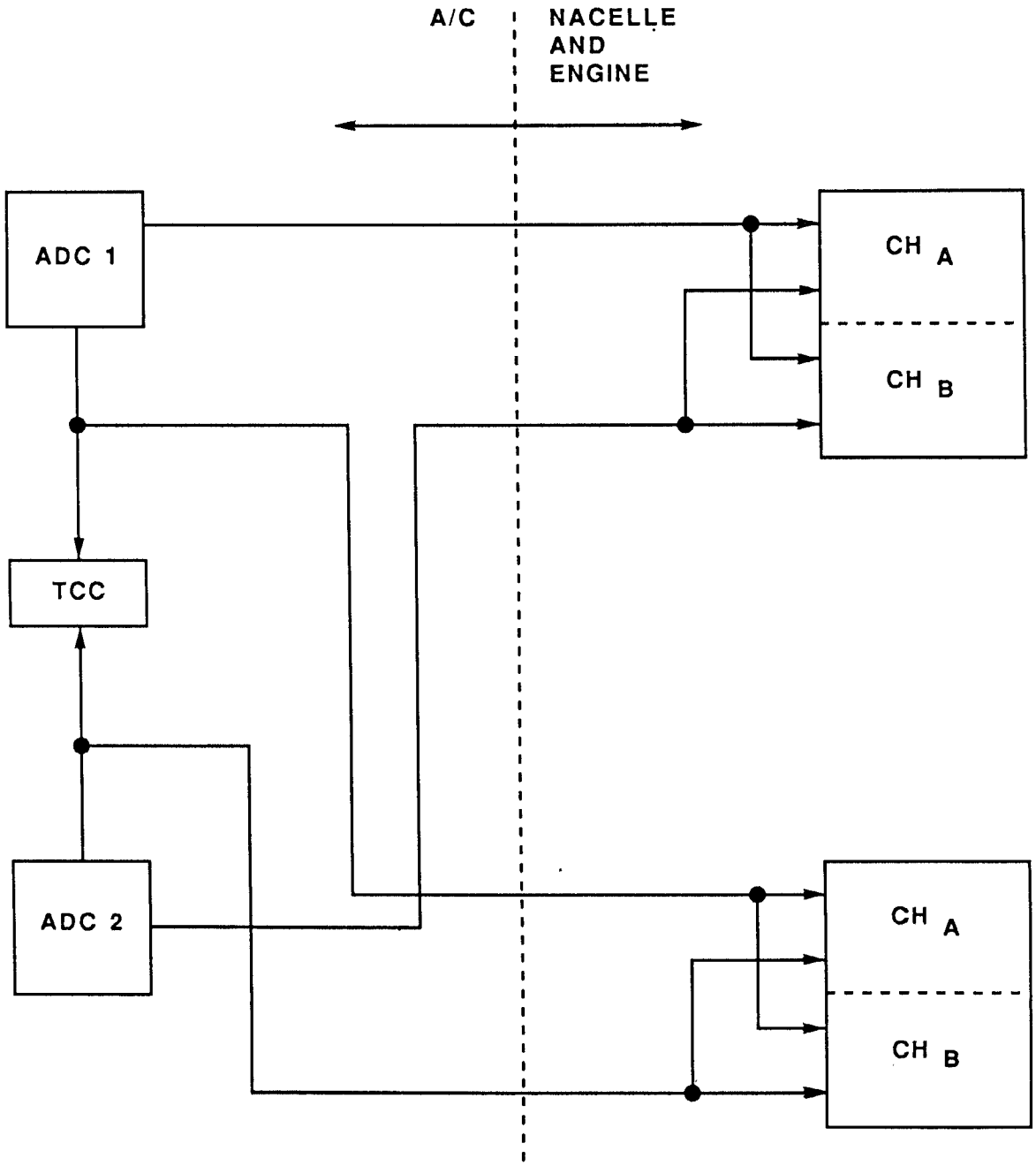
The following general principles are applied in the source selection hierarchy :

- **ADC** inputs are preferred, when validated by engine data, over **FADEC** air data sensor input and are used whenever possible for rating calculations.
- **ADC P2** is not used for **EPR** actual determination.
- For the case where an **ADC** data would be used without comparison with engine data (alternative to the **FADEC** becoming incapable of control due to loss of engine sensors), the **FADEC** will revert to **N1** mode.
- Without a valid engine **P2**, the **EPR** labels (actual and command) will be flagged and the **FADEC** will revert to **N1** mode.

(3)Failure Accommodation

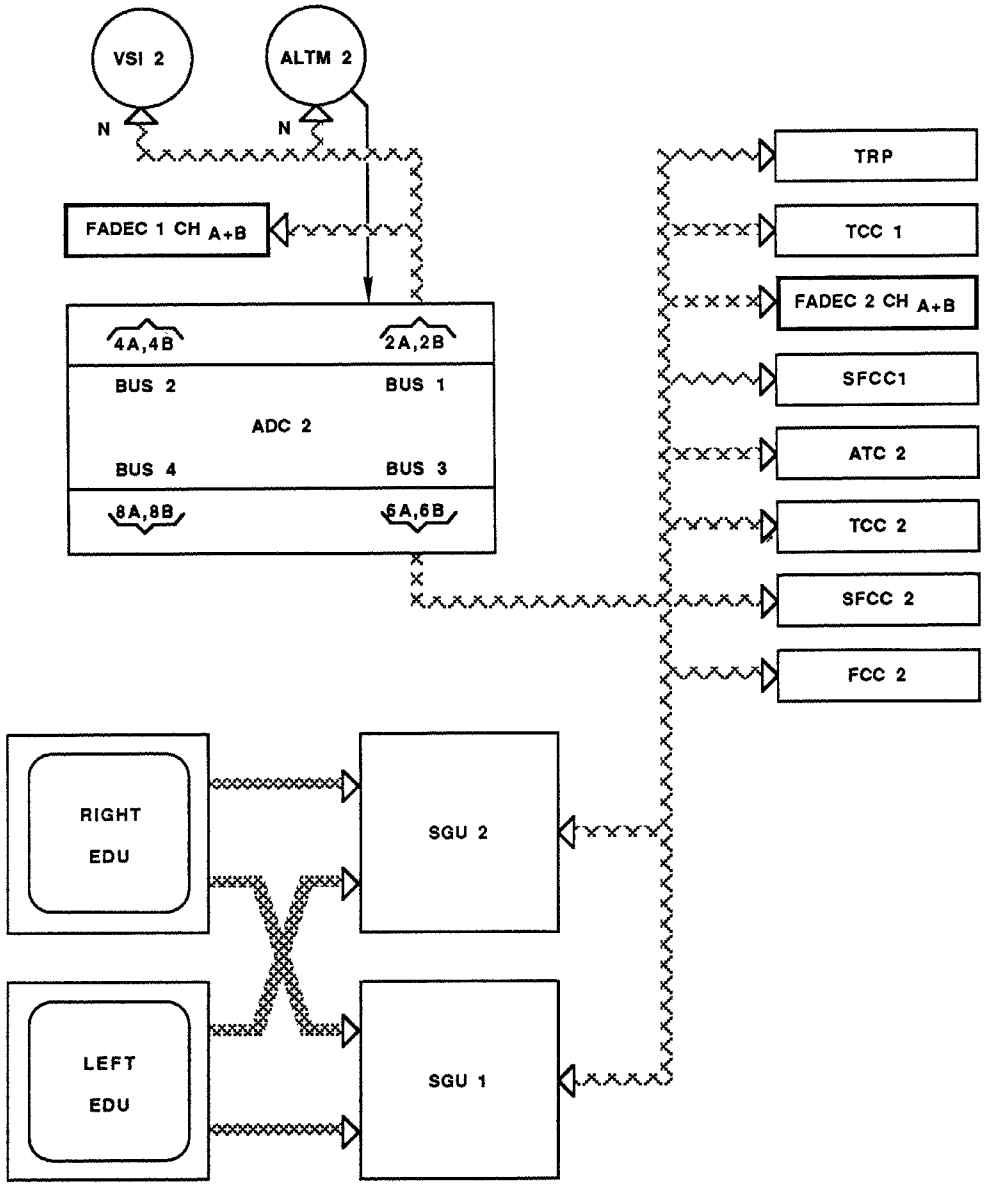
In case of failure of one **ADC** parameters or **ADC** data links, the **FADEC** provides back-up operational mode independent of **ADC** inputs by reverting to engine local sensors and/or synthesized value.

In case of identified **ADC** interface failure by the **FADEC**, a discrete bit will be set in the **FADEC** maintenance words.



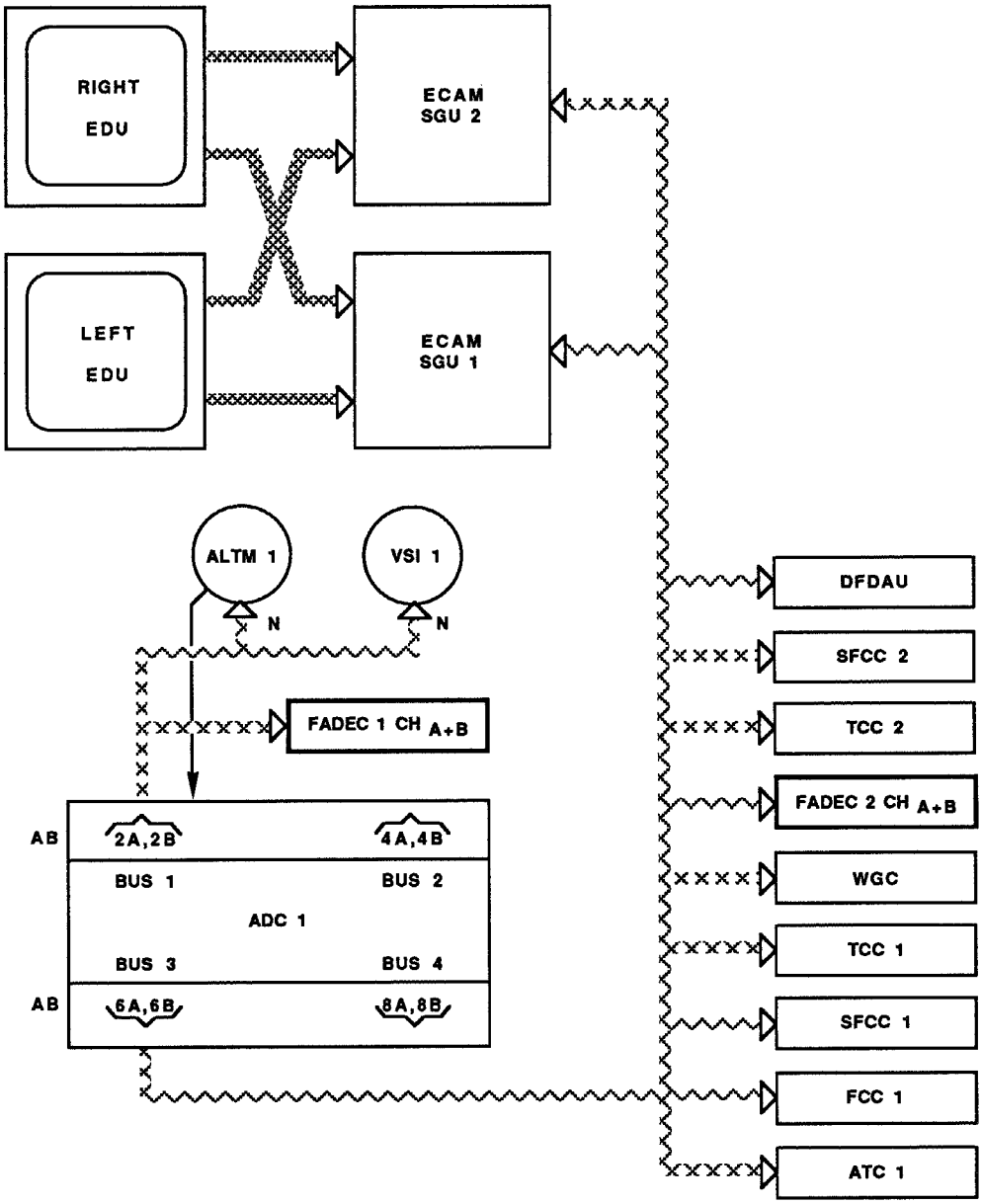
BM5 73 25 00 0 KUNO - 20

FADEC/ADC Crosswiring
Figure 044



BM5 73 25 00 0 KWNO - 21

ADC2 Bus Arrangement
Figure 045



BM5 73 25 00 0 KYNO - 22

ADC1 Bus Arrangement
Figure 046

D. Thrust Control Computer (TCC) Interface

(1)General (Ref. Fig. 047, 048, 049) (and Ref. Table 009)

The FADEC receives, from the TCC, the service bleed and aircraft status in order to ensure the bleed pressure compatibility with the aircraft requirements and to modulate idle.

(2)Service bleed : (Ref. Fig. 050, 051, 052)
(Ref. Fig. 053)

(a)Thrust control computer logic

The thrust control computer receives discretes giving airframe and engine service bleed configurations. There are five elementary bleed configurations.

- no air bleed
- air conditioning air bleed
- half-wing anti-ice air bleed
- full-wing anti-ice air bleed
- engine inlet anti-ice bleed

The TCC generates bit configuration in label 273 representing multipliers for the various bleeds (wing anti-ice, cowl anti-ice and air conditioning), based on the actual position of the following valves.

- engine bleed valves
- air conditioning pack valves
- wing anti-ice valves
- cowl anti-ice valves
- cross feed valve

(b)FADEC function and utilization

The FADEC receives wing anti-ice, cowl anti-ice and air conditioning bleed status from the TCC. The information received from the TCC is used in the rating and minimum burner pressure calculations as described below :

1 Ratings

The FADEC calculates basic delta EPR corrections which are applied as a function based on altitude. The product of the basic delta EPR corrections and the multipliers received from the TCC are then used to modify the calculated ratings.

2 Minimum burner pressure

The FADEC calculates a minimum burner pressure in order to maintain adequate flow for Aircraft/Service bleed requirements.

(3)Aircraft status :

(a)TCC data to FADEC

The FADEC receives aircraft status via two bits within the TCC status word. The WOW bit indicates whether or not the aircraft is on the ground. The second bit (slats retracted) indicates the position of the slats.

(b)FADEC function and utilization

The FADEC uses the aircraft status data in the following logic functions :

- Approach idle selection logic
- Throttle resolver angle fault accommodation logic

1 Approach idle selection logic

WOW and slats position are used in combination to determine the need

for approach idle. Approach idle is selected if in flight and slats are extended, both bits are equal to zero.

2 TRA fault accommodation logic
The FADEC uses the WOW information to determine that the aircraft is on ground.

(4)Failure accommodation :
In case of failure of TCC inputs, the FADEC selects the failsafe state : all zero state.

BIT	FUNCTION	FAILSAFE CONDITION	
11	Air Conditioning 1	OFF-	
12	Air Conditioning 2	OFF	
13	Wing Anti-Icing 1	OFF	*
14	Wing Anti-Icing 2	OFF	
15	Nacelle Anti-Icing	OFF-	
22	Weight On Wheels	AIR -|	**
23	Slats Retracted	EXTENDED-|	

* State in which the least penalty is applied to the calculated ratings. If the failsafe state is selected the minimum burner pressure is maintained at a level which will provide adequate flow for the worst case aircraft bleed requirements.

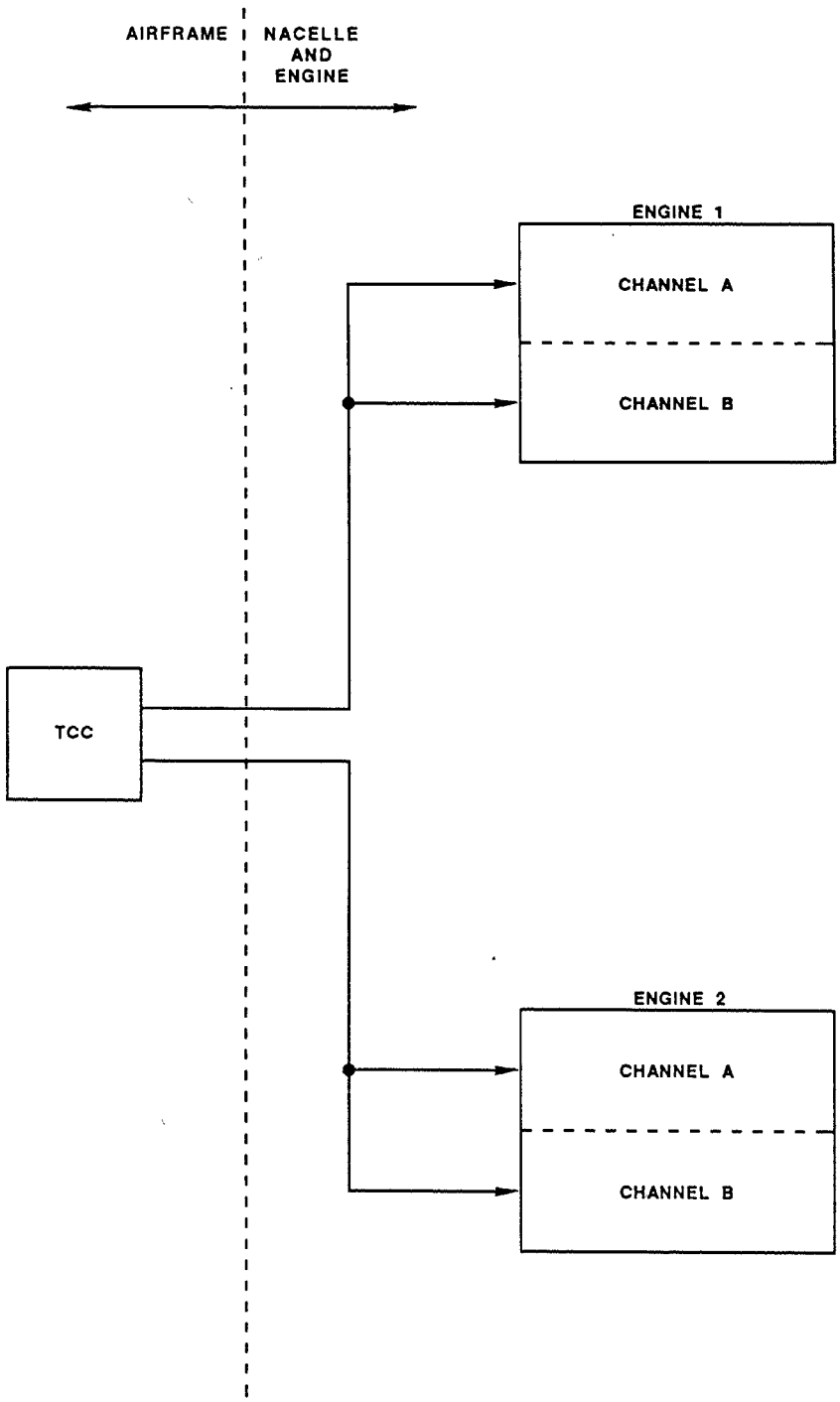
** With loss of weight on wheels and slat position information, the FADEC selects the failsafe state :
Above Mn.12 approach idle : This will ensure the GO Around time capability even with this failure.
Below Mn.12, ground idle will be selected.

NOTE : (Ref. Fig. 050, 051, 052)
(Ref. Fig. 053)
Apply to bits 11, 12, 13, 14 and 15

BIT	FUNCTION	BIT STATUS 1	0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label	X	
8	Label	X	
9	SDI		
10	SDI		
11	Air Conditioning 1	ON	OFF-|
12	Air Conditioning 2	ON	OFF	
13	Wing Anti-icing 1	ON	OFF	
14	Wing Anti-icing 2	ON	OFF	
15	Nacelle Anti-icing	ON	OFF-|
16	Not Used by FADEC		

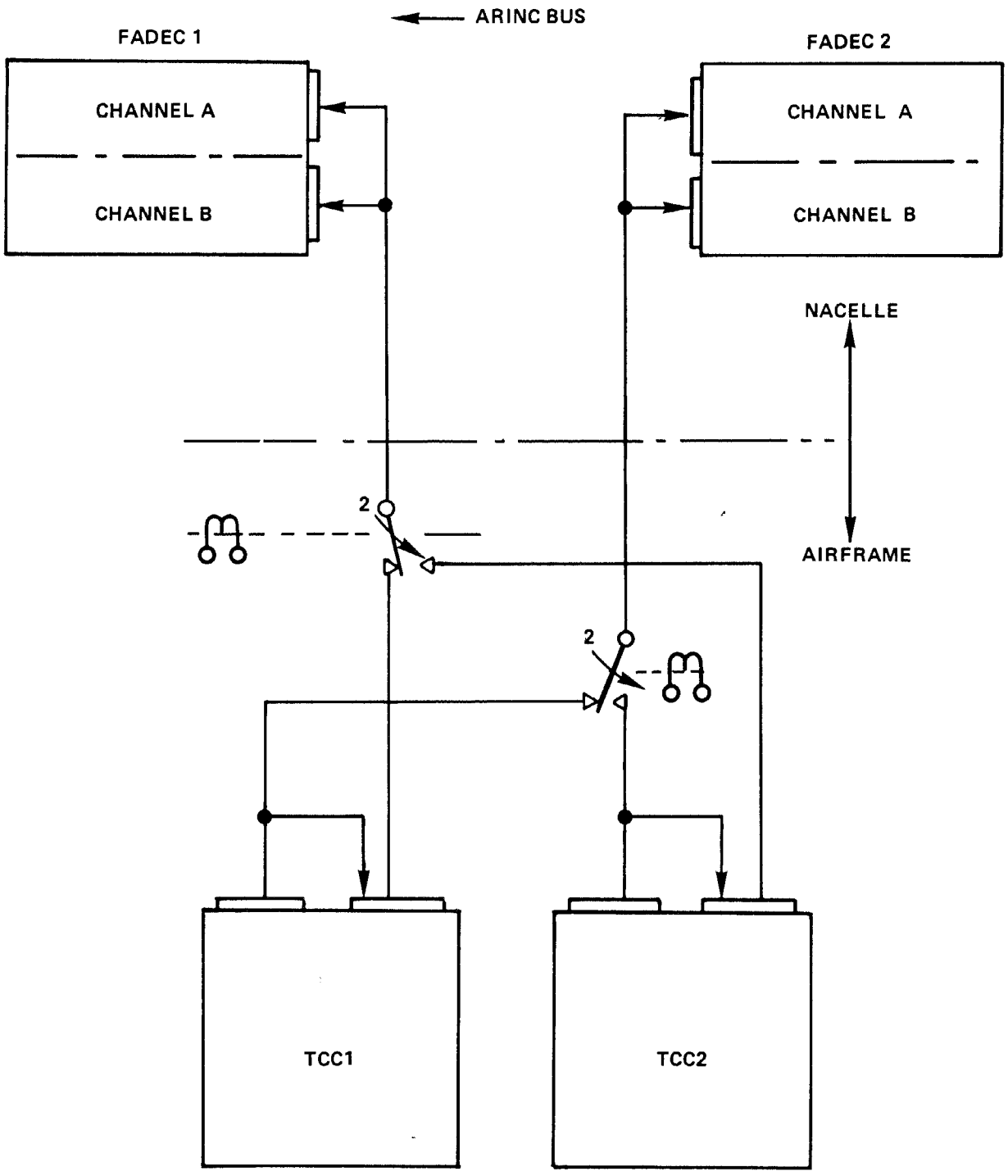
BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
17	Not used by FADEC		
18	Not used by FADEC		
19	Not used by FADEC		
20	Not used by FADEC		
21	Not used by FADEC		
22	Weight On Wheels	Ground	Flight
23	Slats Retracted	Retracted	Extended
24	Not used by FADEC		
25	Not used by FADEC		
26	Not used by FADEC		
27	Not used by FADEC		
28	Not used by FADEC		
29	Not used by FADEC		
30	SSM		
31	SSM		
32	Parity (ODD)		

TCC Status Word No. 4 Label 273
Table 009

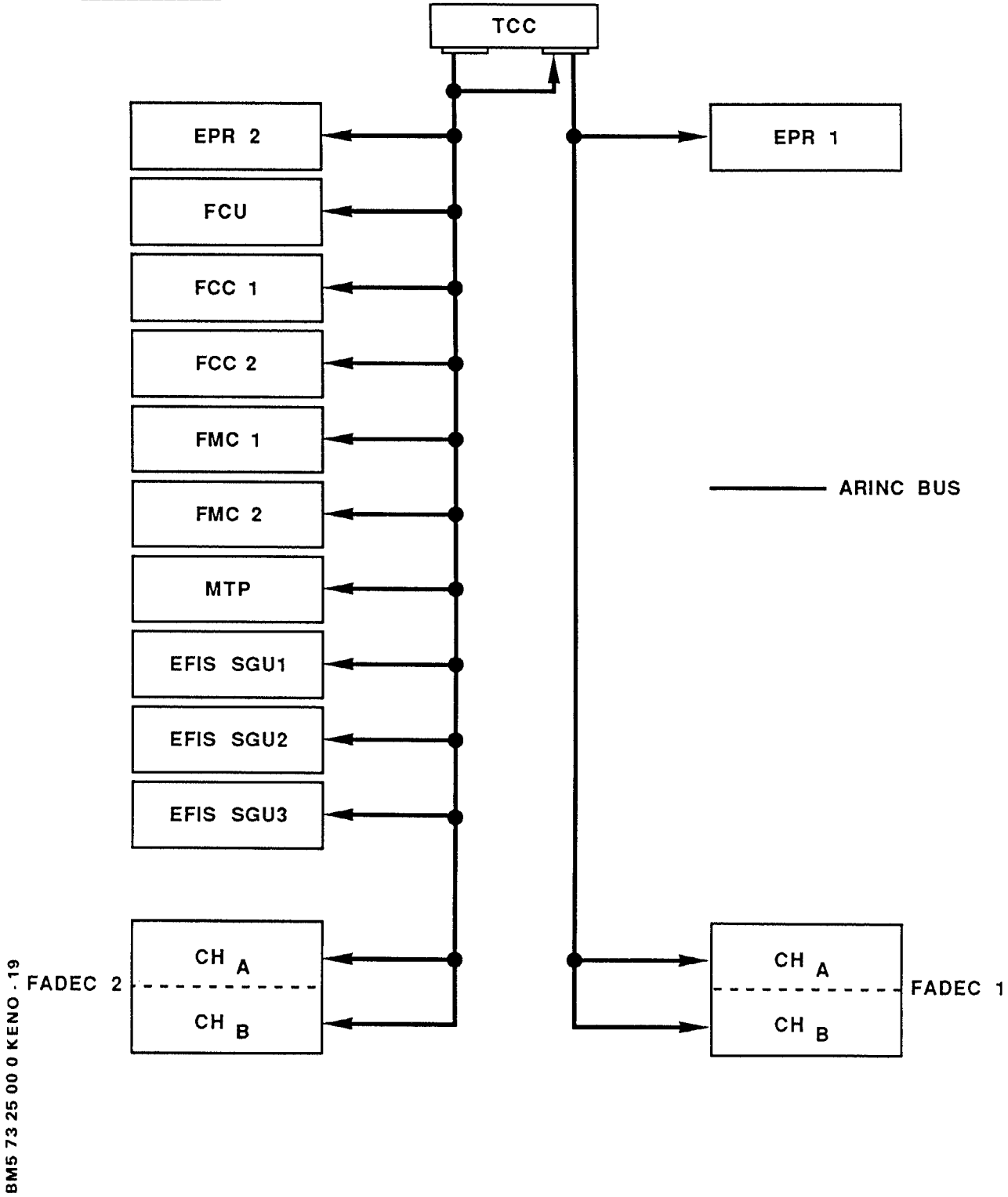


BM5 73 25 00 0 KANO - 20

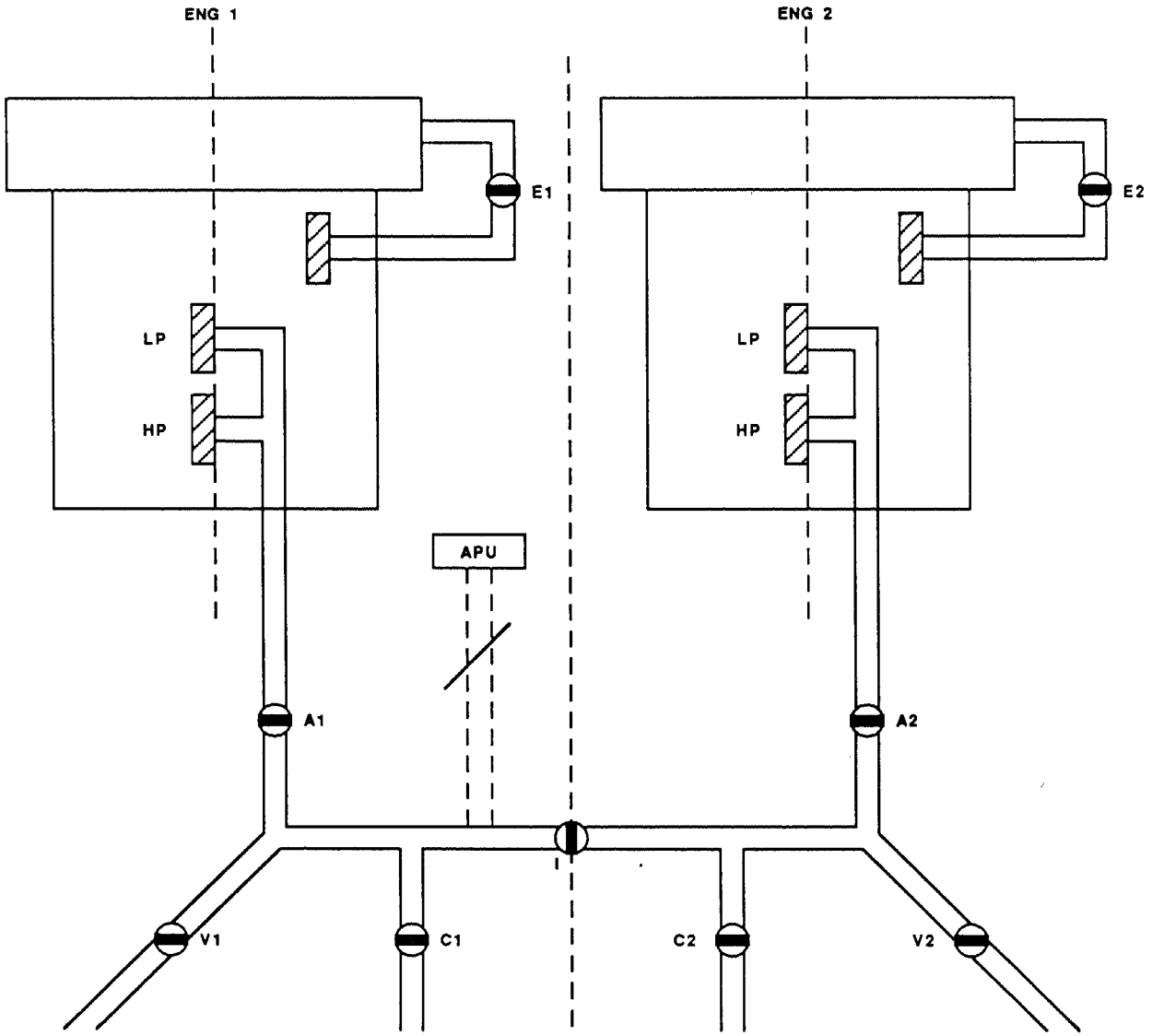
TCC/FADEC Crosswiring
Figure 047



FADEC/TCC Crosswiring TCC Arinc Busses
Figure 048



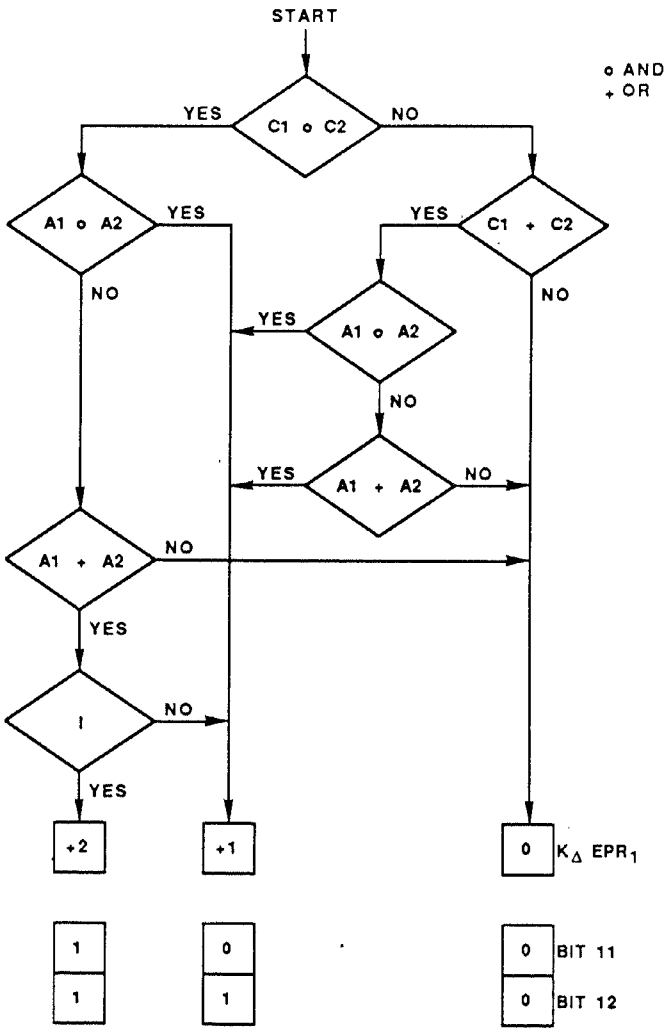
TCC Bus Arrangement
Figure 049



BM5 73 25 00 0 KABO - 20

A1/A2 = ENGINE BLEED VALVE
E1/E2 = NACELLE ANTI-ICE (NAI)
V1/V2 = WING ANTI-ICE (WAI)
C1/C2 = AIR CONDITIONING RACK (A/C)
I = CROSSFEED VALVE

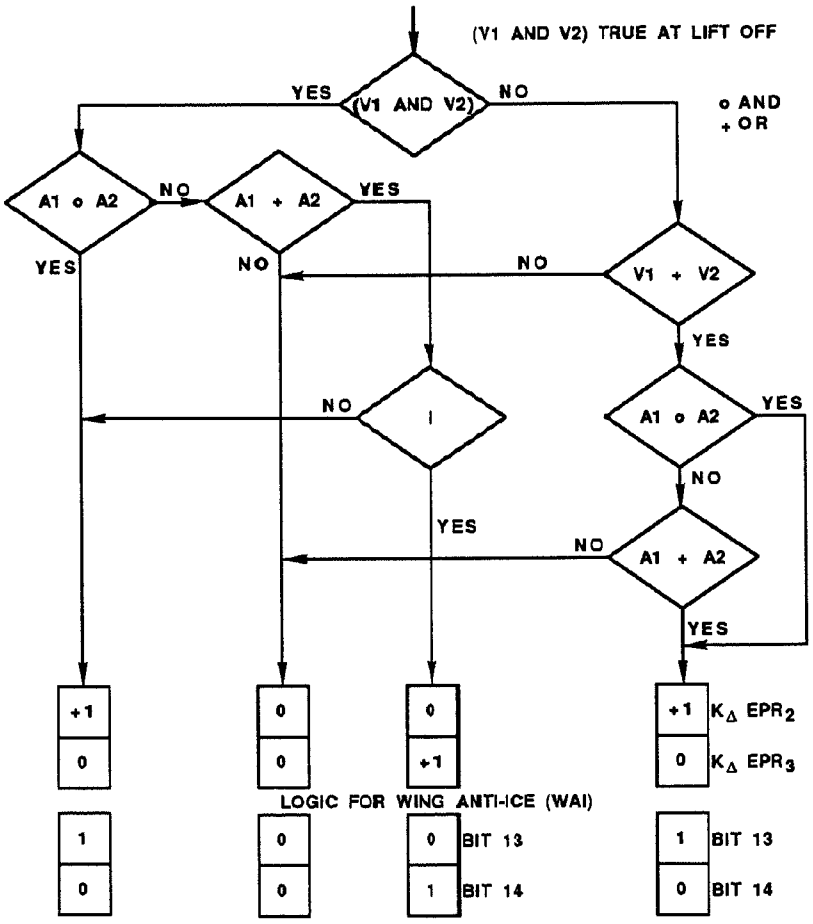
Bleed Valve Configuration
Figure 050



K_Δ EPR$_1$ CORRECTION GAIN CORRESPONDING TO AIR BLEED FOR AIR CONDITIONING
EPR LIMIT COMPUTATION CORRECTIONS DUE TO AIR BLEEDS

BM5 73 25 00 0 KADO - 20

Aircraft Logic for Air Conditioning
Figure 051



K_Δ EPR$_2$ CORRECTION GAIN CORRESPONDING TO AIR BLEED FOR HALF WING ANTI-ICING

K_Δ EPR$_3$ CORRECTION GAIN CORRESPONDING TO AIR BLEED FOR FULL WING ANTI-ICING

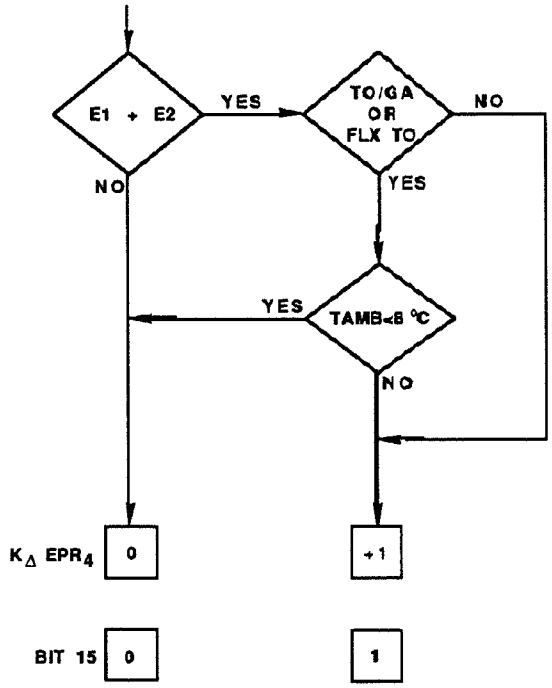
EPR LIMIT COMPUTATION CORRECTIONS DUE TO AIR BLEEDS

BM5 73 25 00 0 KAFO • 01/28 • 01/23
DM5

Aircraft Logic for Wing Anti-Ice
Figure 052

NOTE : (E1 + E2) IS TRUE IF AT LEAST ONE OF THE 2 FOLLOWING ANTI-ICE VALVES IS OPEN :

- ENGINE 1 AIR INTAKE (COWL)
- ENGINE 2 AIR INTAKE
- OR COWL ANTI-ICE SELECTED



K_Δ EPR$_4$ CORRECTION GAIN CORRESPONDING TO AIR BLEED FOR AIR INTAKE ANTI-ICING (COWL) EPR LIMIT COMPUTATION CORRECTIONS DUE TO AIR BLEEDS

BM5 73 25 00 0 KAHO • 01/28 • 01/23
DM5

Aircraft Logic for Cowl Anti-Ice
Figure 053

E. Analog Discretes Interface

(1)Input discretes

(a)P2/T2 probe heat (Ref. Fig. 055)

A current sensor is located in the aircraft system to detect the presence of P2/T2 anti-icing heater power.

The current sensor provides each channel of the FADEC with the probe heat discrete.

The FADEC responds to this discrete as follows :

- An open circuit means probe heater OFF.
- A closed circuit means probe heater ON.

The FADEC uses the probe heat status in the P2 and T2 selection logic to determine the validity of the P2/T2 inputs. The reaction to loss of probe heat is dependent on the status of the aircraft inputs for P2/T2 as well as environmental conditions and engine operating conditions at the time. The probe heat status is ignored on ground (synthesized WOW = 1) if N2 is less than 55 % to allow time during spool-up for heat to be applied.

(b)Fire (Ref. Fig. 056)

A switch detects the engagement of the engine fire handle in the flight compartment. If the fire discrete is set true, the FADEC will command the engine air/oil heat exchanger and turbine case cool system to the closed position.

In addition, the FADEC commands the IDG AOHE override solenoid to the non-override position thus allowing the valve to take the position commanded by the GCU. The engine AOHE and TCC valves are closed in order to reduce the air supply to the engine core compartment to increase the efficiency of the fire extinguishing system. Each channel of the FADEC responds to the switch as follows :

- A closed circuit means engine fire.
- An open circuit means no fire.

(c)Alternate mode select (Ref. Fig. 057)

A switch is located in the flight compartment to permit the flight crew to select the alternate control mode. The selection allows the pilot to match up the throttles in the event that failures within one of the engine's FADEC systems results in automatic reversion of that system to the alternate mode. In addition, the mode switch removes the trim which is locked in at the time of an automatic reversion. This trim implementation is used to prevent a thrust loss during automatic reversion. The switch can be used to transition from the N1 mode back to the EPR mode if the fault which caused a reversion is cleared. This does not reset the processor but simply allows a reselection of a healthy EPR mode.

Each channel of the FADEC responds to the switch as follows :

- An open circuit means automatic mode selection : pushbutton switch in pressed position.
- A closed circuit means the alternate mode has been manually selected : MODE pushbutton switch in released position.

The discretes are controlled by switches located in the mode select pushbutton switch on overhead panel 429VU.

When the N1 mode is manually selected, N1 legend comes on (white) on the MODE pushbutton switch.

Remark : The N1 light is only illuminated when the EEC is powered.

Refer to paragraph "Electrical Power Supply" for EEC power supply conditions.

Remark : in N1 mode the Thrust Control Computer is automatically disconnected.

(d)External reset (Ref. Fig. 058)

A switch closure (one to each channel) is activated when the HP fuel SOV control lever is placed in the OFF position. This feature is used to insure proper FADEC operation for those cases where the engine is restarted and N2 was above minimum PMA power up speed. The FADEC senses this closure and reinitializes.

This discrete input is used by hardware as well as software. Software is able to read the position of this discrete. The hardware portion of this reset is generated by the edge of the contact closure.

Thus, transition from open to closed : reinitialization
transition from closed to open : no reaction
while switch contact is open : no reaction
while switch contact is closed : no reaction

Reinitialization takes less than 1.5 seconds.

Reinitialization performs the following tasks :

- Reset of overspeed latch
- Reset of all latched faults
- Channel synchronization
- Watch dog timer check.

The discretes (1 to each channel) are sent to the FADEC from independent switches in the HP fuel SOV control lever.

(e)Maintenance discrete (Ref. Fig. 054)

(Ref. Fig. 054)

The setting of this discrete along with various other criteria will allow entrance into the maintenance mode. The maintenance mode allows retrieving during ground testing of in-flight data stored in the FADEC Non-Volatile Memory (NVM).

Once in the maintenance mode, cycling of the discrete will allow reading of faults from previous flight legs.

For description of the maintenance mode (Ref. 73-38-00). Each channel of the control responds to the switch as follows :

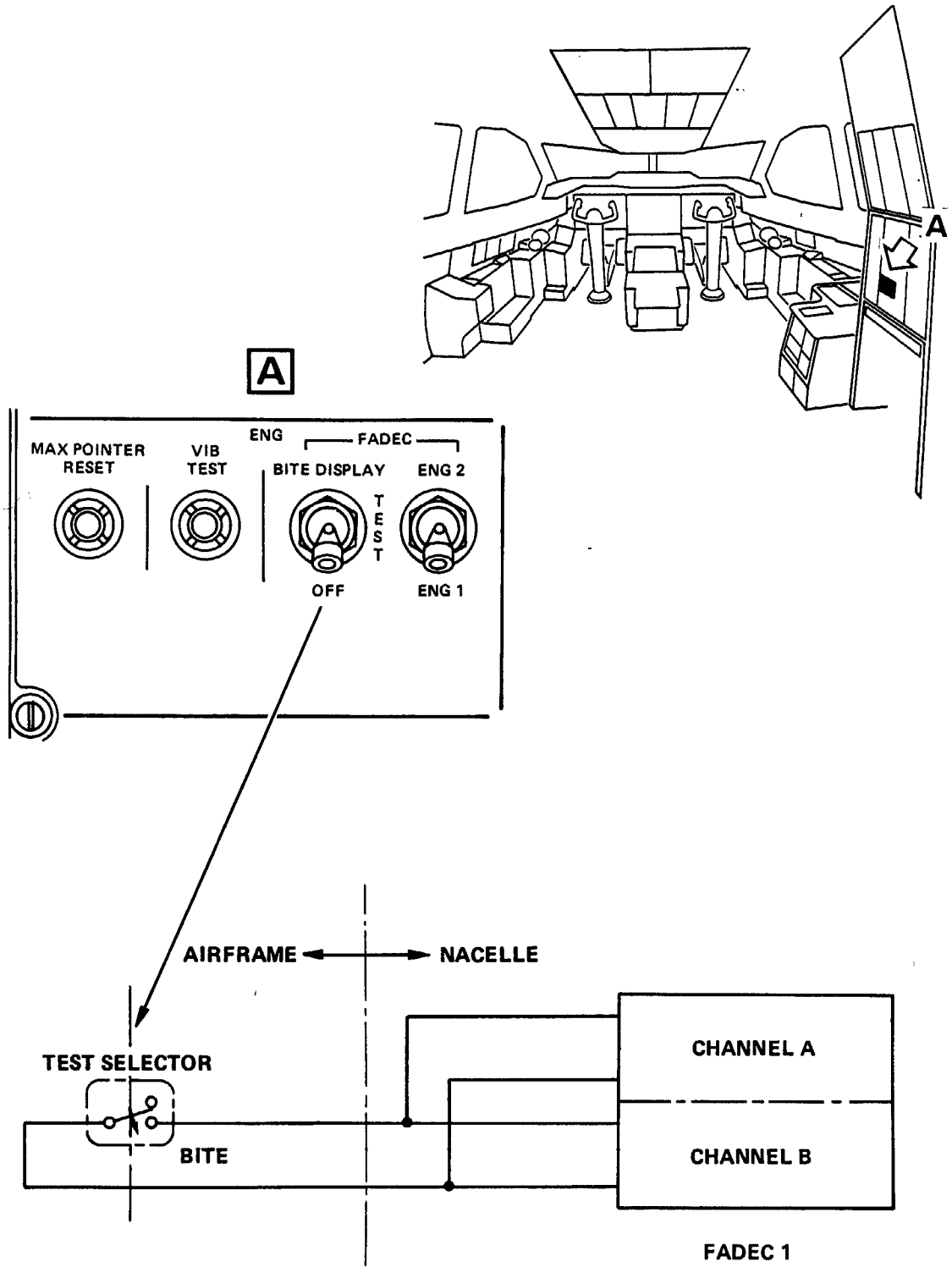
- A closed circuit means NVM retrieving.
- An open circuit means normal operation.

This discrete is sent by the ENG/FADEC/BITE DISPLAY/TEST switch located on the maintenance panel.

To retrieve the Non-Volatile Memory (NVM) it is necessary that the switch be cycled from the ground test position to the BITE display position and then be returned in ground test position. After this sequence 350 maintenance words, from last flight where faults occurred, are displayed. New cycles will allow retrieving from previous flights.

(f)Failure accommodation

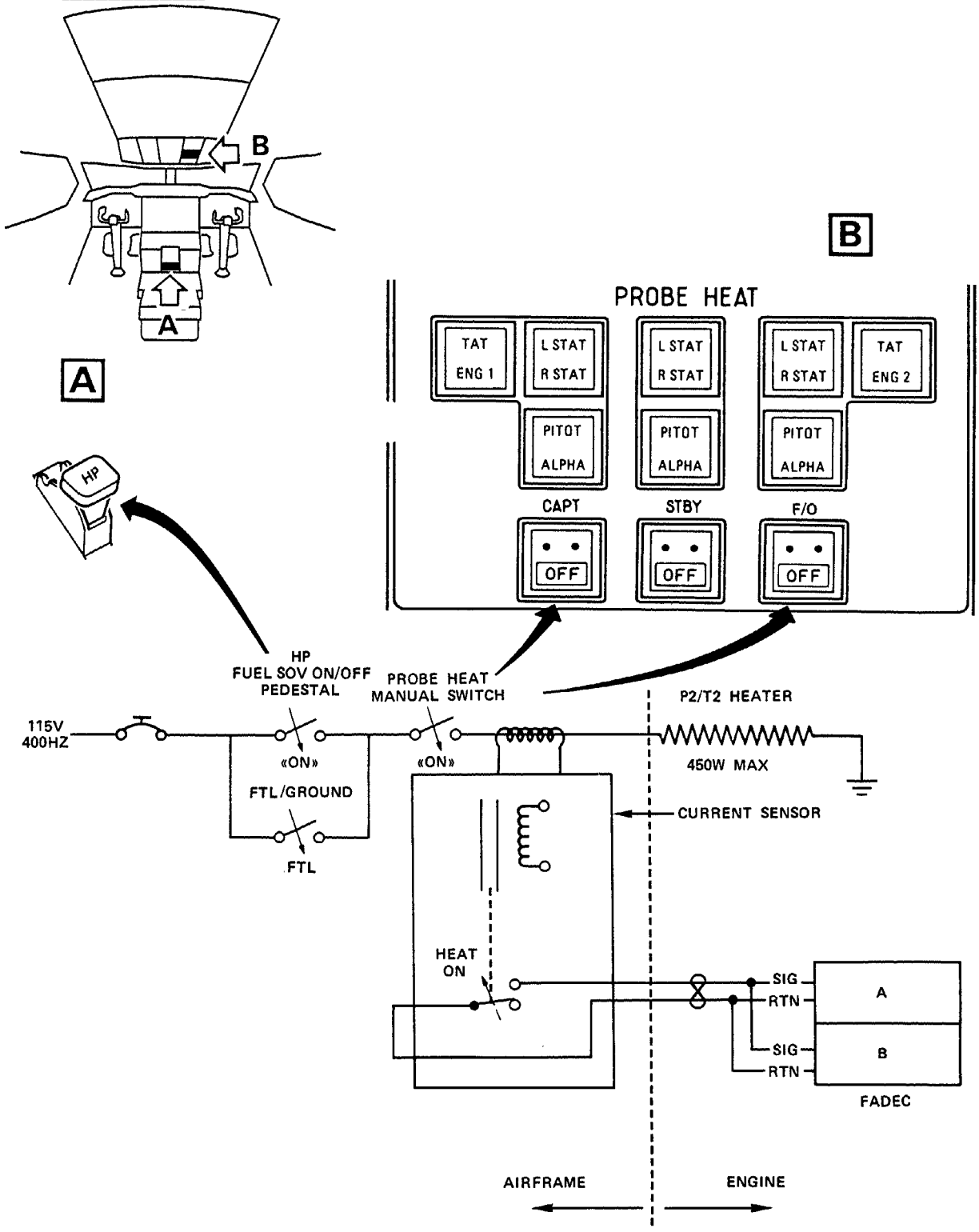
Each FADEC channel receives two sources of external hardwired discretes. A fault condition exists if the discretes are in disagreement, and the channel crosstalk is good. The FADEC accommodates these faults by selecting the discrete in the failsafe mode. The discretes are failsafed as follows :



Maintenance Discretes
Figure 054

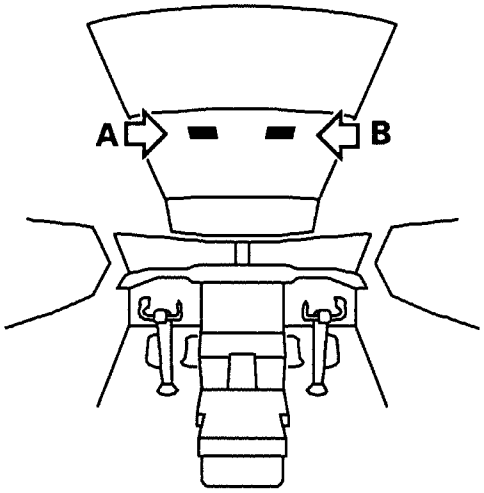
DISCRETE	FAILSAFE
- P2/T2 Probe Heat	Heat Off
- Fire	No Fire
- Mode Select	Alternate Mode
- Reset	No Reset
- Maitenance	No Maintenance Mode

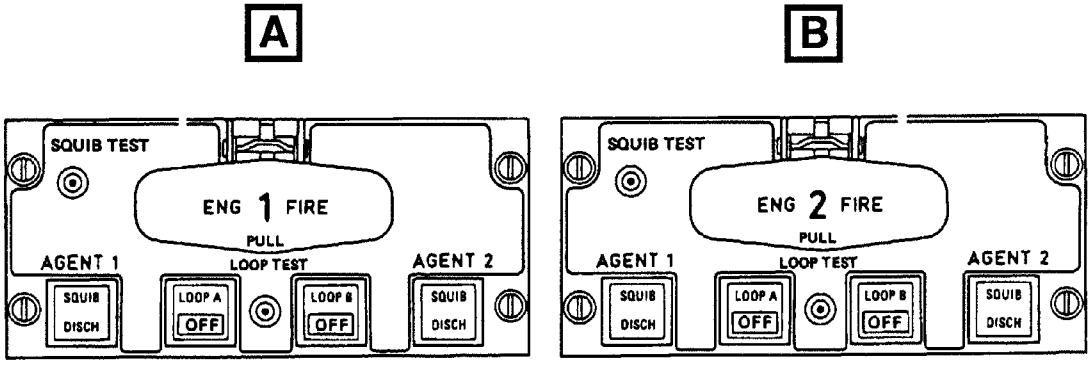
(2)Output discrete
(a)Alternate mode (Ref. Fig. 057)
A circuit closure in the FADEC indicates that the control has been manually selected or has automatically reverted to the non-rating alternate mode after fault accommodation.
This signal is used to drive a local indication (FAULT amber legend on the MODE pushbutton switch) in redundance of the digital information received by the warning system.
The FAULT legends go off as soon as the N1 mode is manually selected.

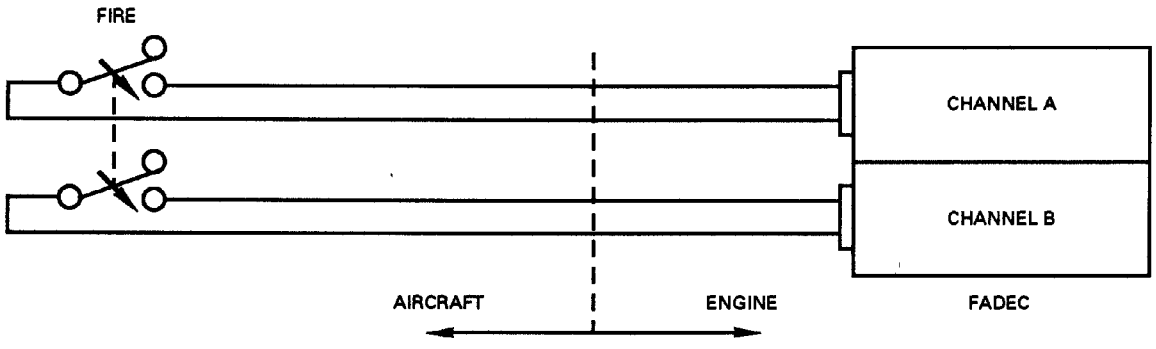


BM5 73 25 00 0 KGNO - 00

Probe Heat Discretes
Figure 055

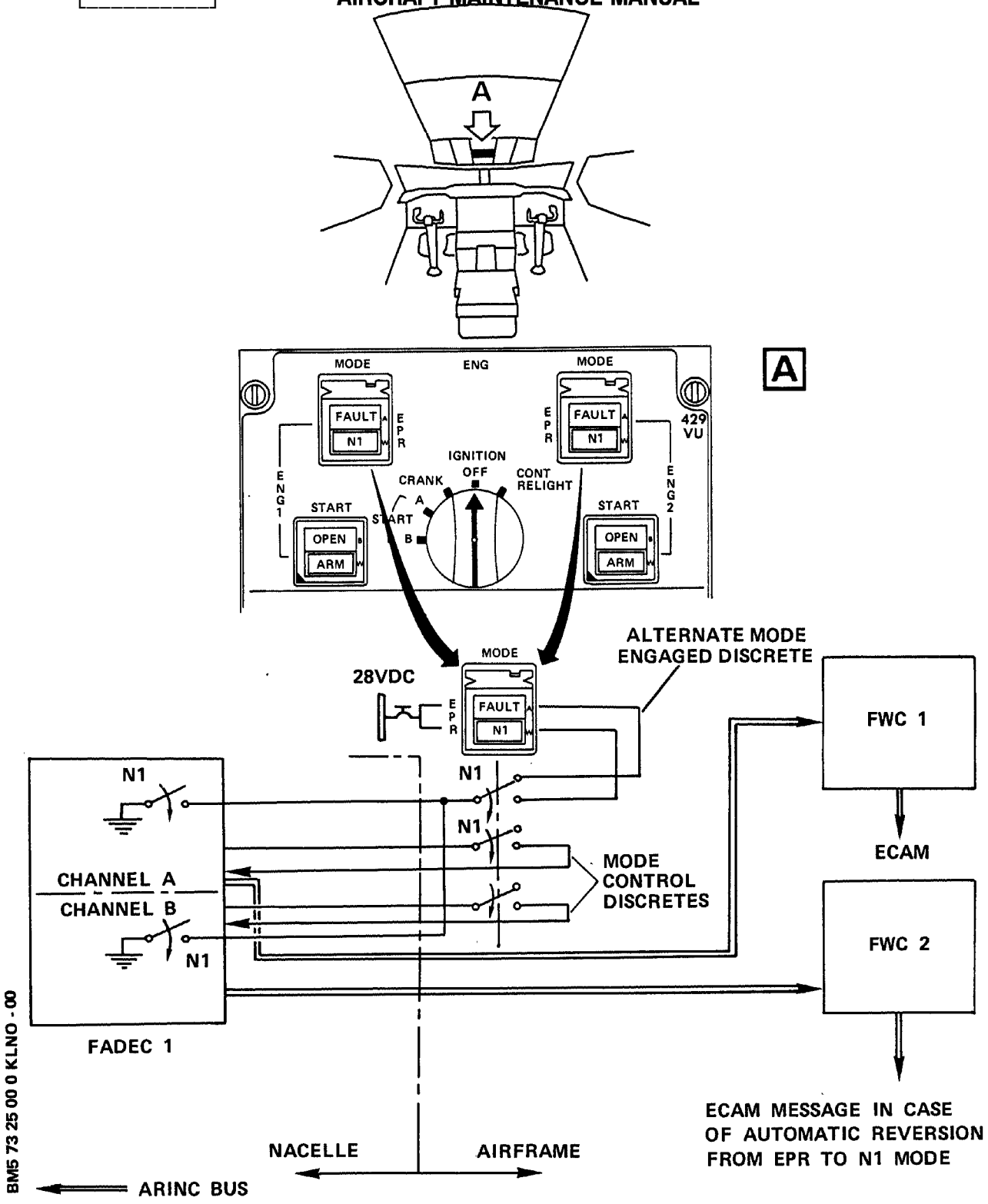




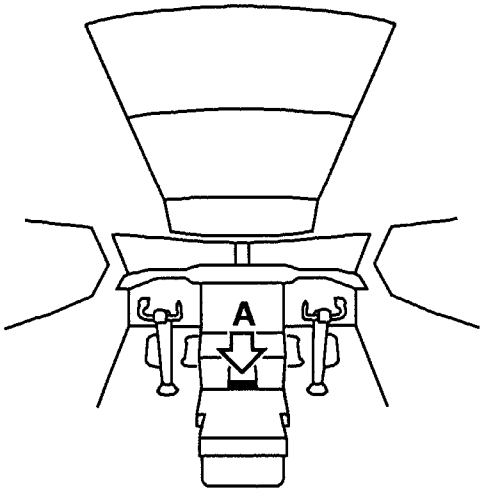


BM5 73 25 00 0 KJNO - 00

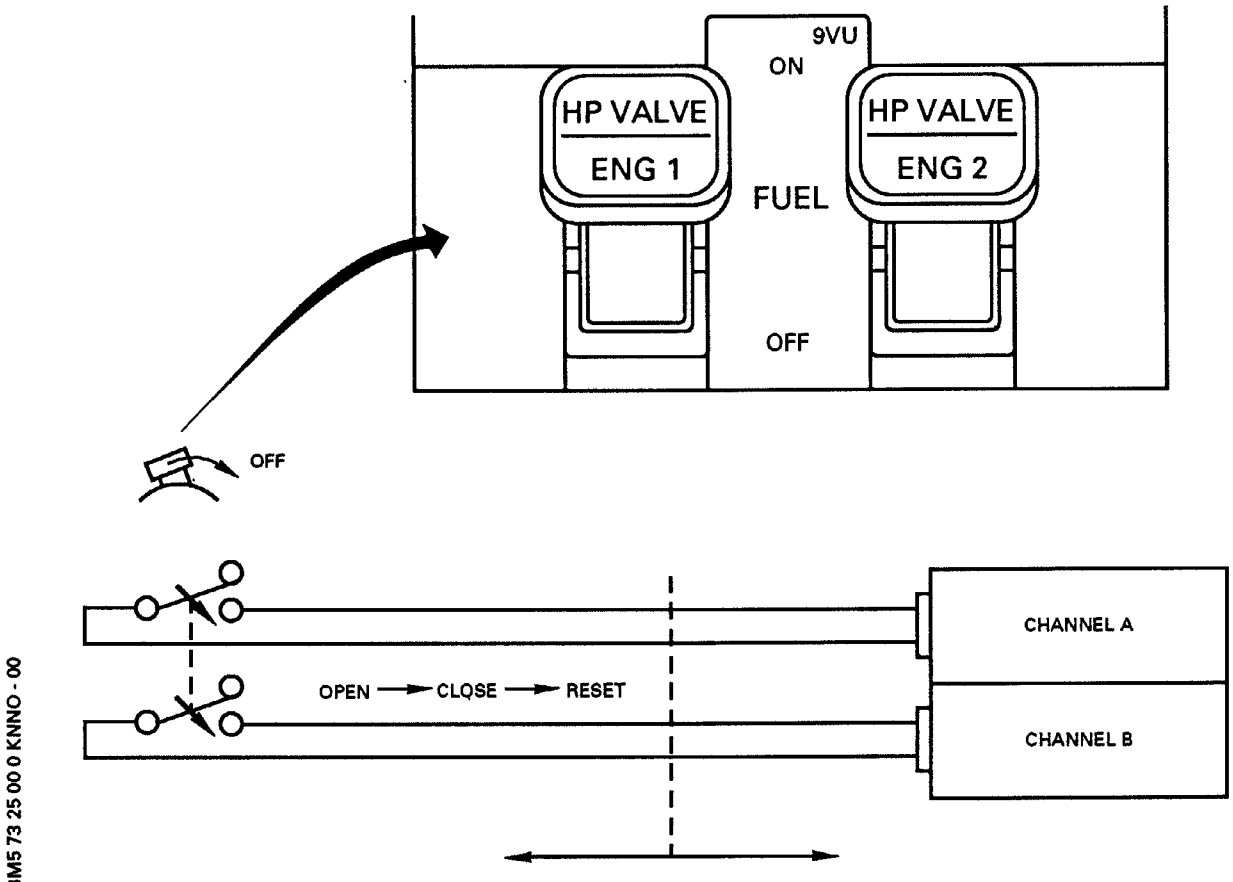
Fire Discretes
Figure 056



Mode Control and Indication Discretes
Figure 057



A



Reset Discretes
Figure 058

F. Electrical Power Supply

(1)28-VDC aircraft power supply

The FADEC system is designed to operate all essential engine control functions with the power provided by the dedicated alternator.
The FADEC system is also designed to operate with aircraft power. The 28-VDC power is used to :
- operate all essential engine control functions in case of PMA failure.
- provide for ground check without the engine running
- provide power for the non-essential/performance system solenoids.

The EEC is powered in the following conditions :
- when the engine is running
- when the ignition selector switch is in crank or start position
- during the first 5 minutes after initial aircraft power up
- 5 minutes after engine shut down
- when FADEC switch is in test position on the MTP.

(a)Ground check

(Ref. Fig. 059)

Aircraft electrical power can be connected to power the engine control system of each engine for testing purposes when the engine is not running. Selection of this power is made in flight compartment by ENG/ FADEC/BITE DISPLAY/TEST switch. This switch is interlocked via the HP FUEL shut off valve control lever. When the engine fuel is turned on, the ground test power is inhibited.

(b)Electrical power interface, solenoids (Ref. Fig. 060)

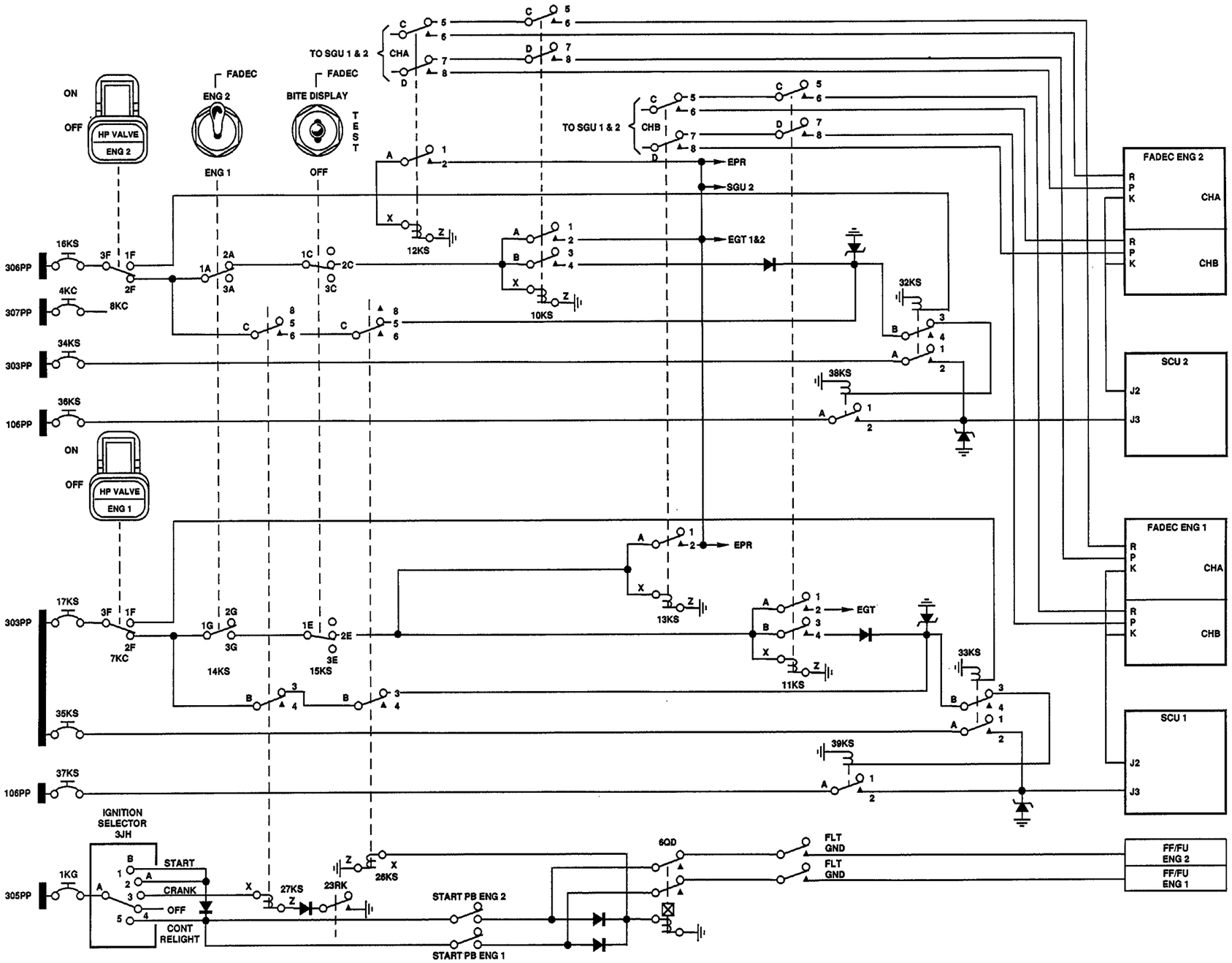
The FADEC has the capability to control the operation of up to 5 solenoids per channel which are powered from the aircraft electrical system. Any of these solenoids can be switched to the ON state by either channel of the FADEC.
In order to provide protection against coil shorts or high side switch shorts to ground, the FADEC incorporates current sensing hardware. Excessive current drain on any solenoid of a channel will result in depowering all individual solenoids of the group.
The system solenoids consist of fuel oil cooler bypass, Thermatic Rotor Control, turbine (blade and vane) cooling air (channel A only) and IDG air/oil heat exchanger override solenoid.
A single point failure in the driving stage, harness of coil(s) does not prevent the FADEC from de-energizing the solenoids. These solenoids are energized via a high side switch closure to +28V and a low side switch closure to ground.

**ON A/C 101-105,

Post SB 71-2024 For A/C 101-105,

Post SB 73-2029 For A/C 101-105,

Aircraft electrical power can be connected to power the engine control system of each engine for testing purposes when the engine is not running. Selection of this power is made in flight compartment by ENG/



BMS 73 25 00 0 KRVO - 00

Ground Test Power Supply
Figure 059

FADEC/BITE DISPLAY/TEST switch. This switch is interlocked via the HP FUEL shut off valve control lever. When the engine fuel is turned on, the ground test power is inhibited.

(b)Electrical power interface, solenoids (Ref. Fig. 061)

The FADEC has the capability to control the operation of up to 5 solenoids per channel which are powered from the aircraft electrical system. Any of these solenoids can be switched to the ON state by either channel of the FADEC.

In order to provide protection against coil shorts or high side switch shorts to ground, the FADEC incorporates current sensing hardware. Excessive current drain on any solenoid of a channel will result in depowering all individual solenoids of the group.

The system solenoids consist of fuel oil cooler bypass, turbine (blade and vane) cooling air (channel A only) and IDG air/oil heat exchanger override solenoid.

A single point failure in the driving stage, harness of coil(s) does not prevent the FADEC from de-energizing the solenoids. These solenoids are energized via a high side switch closure to +28V and a low side switch closure to ground.

**ON A/C 101-200,

(c)Electrical power interface, SCU

FADEC is powered via SCU in case of PMA failure.

Annunciator circuit (FADECs Status Word No. 3, Label 272 Bit 29) indicates that FADEC power supply is performed via SCU instead of PMA.

(2)115V Power supply (Ref. Fig. 062)

The 115VAC aircraft power supply provides normal bus power for P2/T2 probe heater.

(a)P2/T2 probe

The P2/T2 combination probe signals are used to validate the air data computer P2 and T2 signals. It provides a validation function if the two air data computers differ in their respective values of P2 or T2. The probe is electrically de-iced by power from aircraft system. The current to this probe's heater is sensed and sets an on-off switch closure discrete signal to the FADEC.

(3)Power requirements

The FADEC system aircraft power requirements are presented in the following table :

ITEM	NUMBER USED	VOLTAGE	MAX CURRENT (amps)	UNPOWERED CONDITION
Turbine (blade and vane) Cooling Air Solenoid	1	28 VDC	0.75	Air On
Thermatic Rotor Control/ Thrust Balance Vent	2	28 VDC	0.75 per solenoid	9th Stage Air On/TB Vent Open
Fuel/Oil Cooler Bypass Solenoid	1	28 VDC	0.75	No Oil Bypass

ITEM	NUMBER USED	VOLTAGE	MAX CURRENT (amps)	UNPOWERED CONDITION
IDG Air/Oil Heat Exchanger O/R Solenoid	1	28 VDC	0.75	IDG Air/Oil Heat Exchanger Air Valve Open
Ground Test	2	28 VDC	1.75 per channel	FADEC Off (Engine not running)
P2/T2 Heater	1	115V 400 Hz	3.9	Heater Off
FADEC Channel Capable Relay	2	28 VDC	0.25	Lamp Off
Alternate Mode Relay	2	28 VDC	0.25	Lamp Off

(4)Loss of electrical power

(a)Loss of 28VDC aircraft power supply

Each FADEC channel receives two sources of aircraft DC power. The following accommodation takes place if power is lost :
Loss of aircraft DC power to a channel is accommodated by the FADEC controlling these functions using the other channel. If the other channel has also lost this power or is incapable of commanding these outputs due to other faults, the outputs on the affected DC bus will assume their failsafe depowered states.

(b)Loss of 115 VAC power supply

The reaction to loss of 115VAC power supply (loss of PT2 KT2 probe heat) is dependent on the status of the aircraft inputs for P2/T2 as well as environmental conditions and engine operating conditions.
Loss of A/C power to inlet probe is accommodated by the FADEC as follows :
If engine data agree with ADC, or disagree with ADC but with ambient temperature above 7.2°C, the engine will continue to operate in EPR mode provided ADC probes are deiced.
If above mentioned conditions are not met, the FADEC will revert to the N1 mode.

**ON A/C 101-105,

Post SB 71-2024 For A/C 101-105,

(c)Electrical power interface, SCU

FADEC is powered via SCU in case of PMA failure.
Annunciator circuit (FADECs Status Word No. 3, Label 272 Bit 29) indicates that FADEC power supply is performed via SCU instead of PMA.

(2)115V Power supply (Ref. Fig. 062)

The 115VAC aircraft power supply provides normal bus power for P2/T2 probe heater.

(a)P2/T2 probe

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(3)Power requirements

The FADEC system aircraft power requirements are presented in the following table :

ITEM	NUMBER USED	VOLTAGE	MAX CURRENT (amps)	UNPOWERED CONDITION
Turbine (blade and vane) Cooling Air Solenoid	3	28 VDC	0.75	Air On
Fuel/Oil Cooler Bypass Solenoid	1	28 VDC	0.75	No Oil Bypass

ITEM	NUMBER USED	VOLTAGE	MAX CURRENT (amps)	UNPOWERED CONDITION
IDG Air/Oil Heat Exchanger O/R Solenoid	1	28 VDC	0.75	IDG Air/Oil Heat Exchanger Air Valve Open
Ground Test	2	28 VDC	1.75 per channel	FADEC Off (Engine not running)
P2/T2 Heater	1	115V 400 Hz	3.9	Heater Off
FADEC Channel Capable Relay	2	28 VDC	0.25	Lamp Off
Alternate Mode Relay	2	28 VDC	0.25	Lamp Off

(4)Loss of electrical power

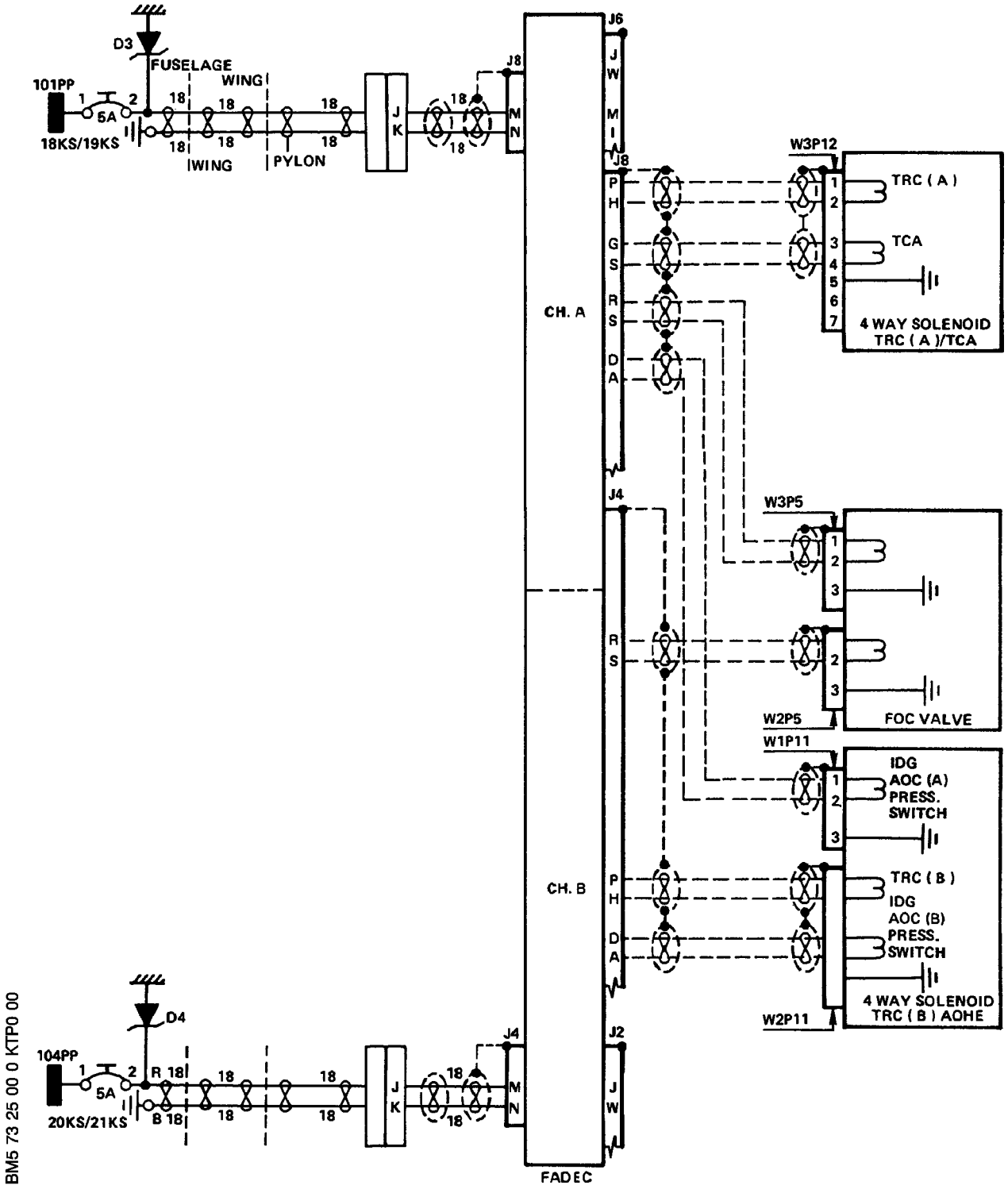
(a)Loss of 28VDC aircraft power supply

Each FADEC channel receives two sources of aircraft DC power. The following accommodation takes place if power is lost :
Loss of aircraft DC power to a channel is accommodated by the FADEC controlling these functions using the other channel. If the other channel has also lost this power or is incapable of commanding these outputs due to other faults, the outputs on the affected DC bus will assume their failsafe depowered states.

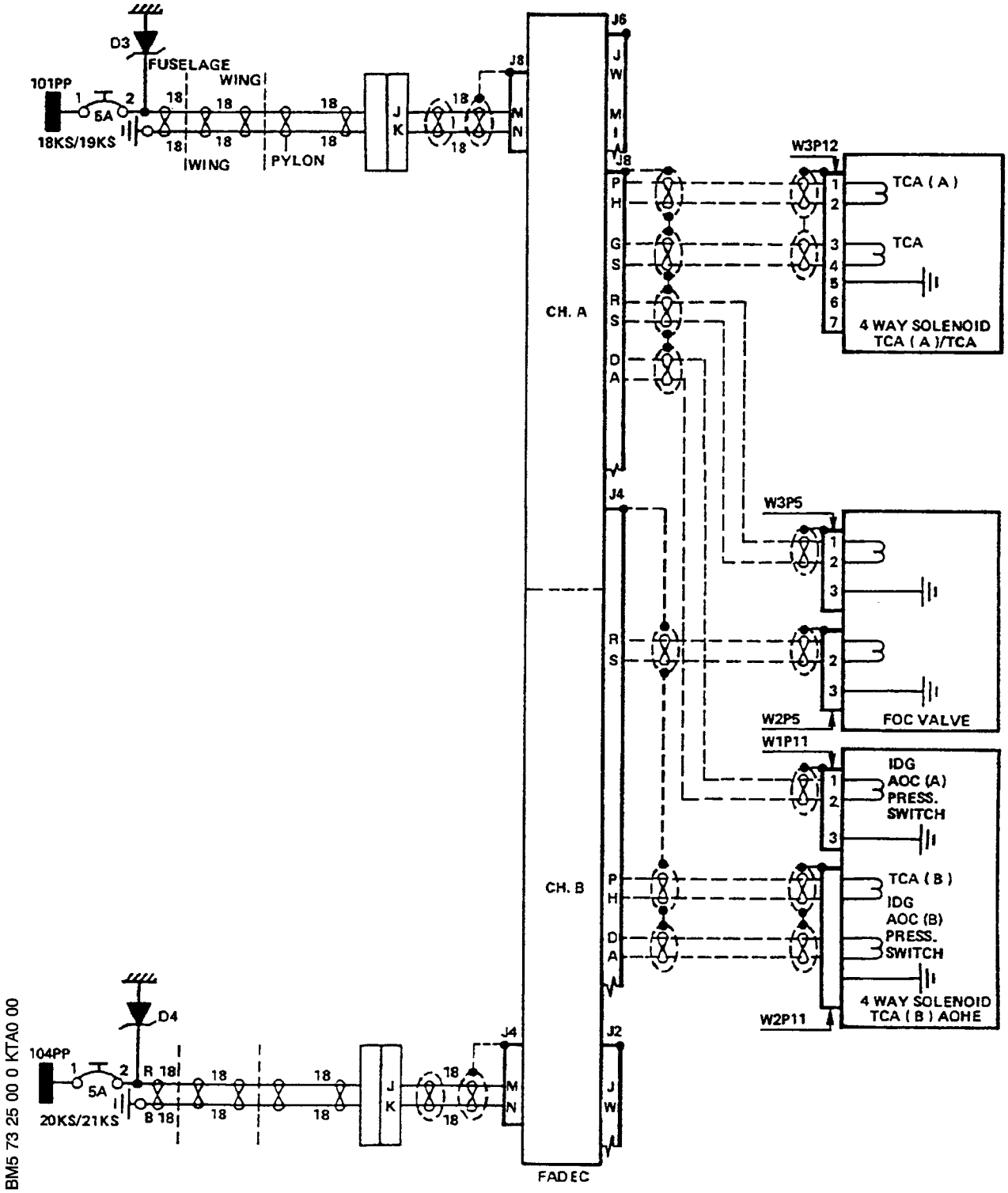
(b)Loss of 115 VAC power supply

The reaction to loss of 115VAC power supply (loss of PT2 KT2 probe heat) is dependent on the status of the aircraft inputs for P2/T2 as well as environmental conditions and engine operating conditions.
Loss of A/C power to inlet probe is accommodated by the FADEC as follows :
If engine data agree with ADC, or disagree with ADC but with ambient temperature above 7.2°C, the engine will continue to operate in EPR mode provided ADC probes are deiced.
If above mentioned conditions are not met, the FADEC will revert to the N1 mode.

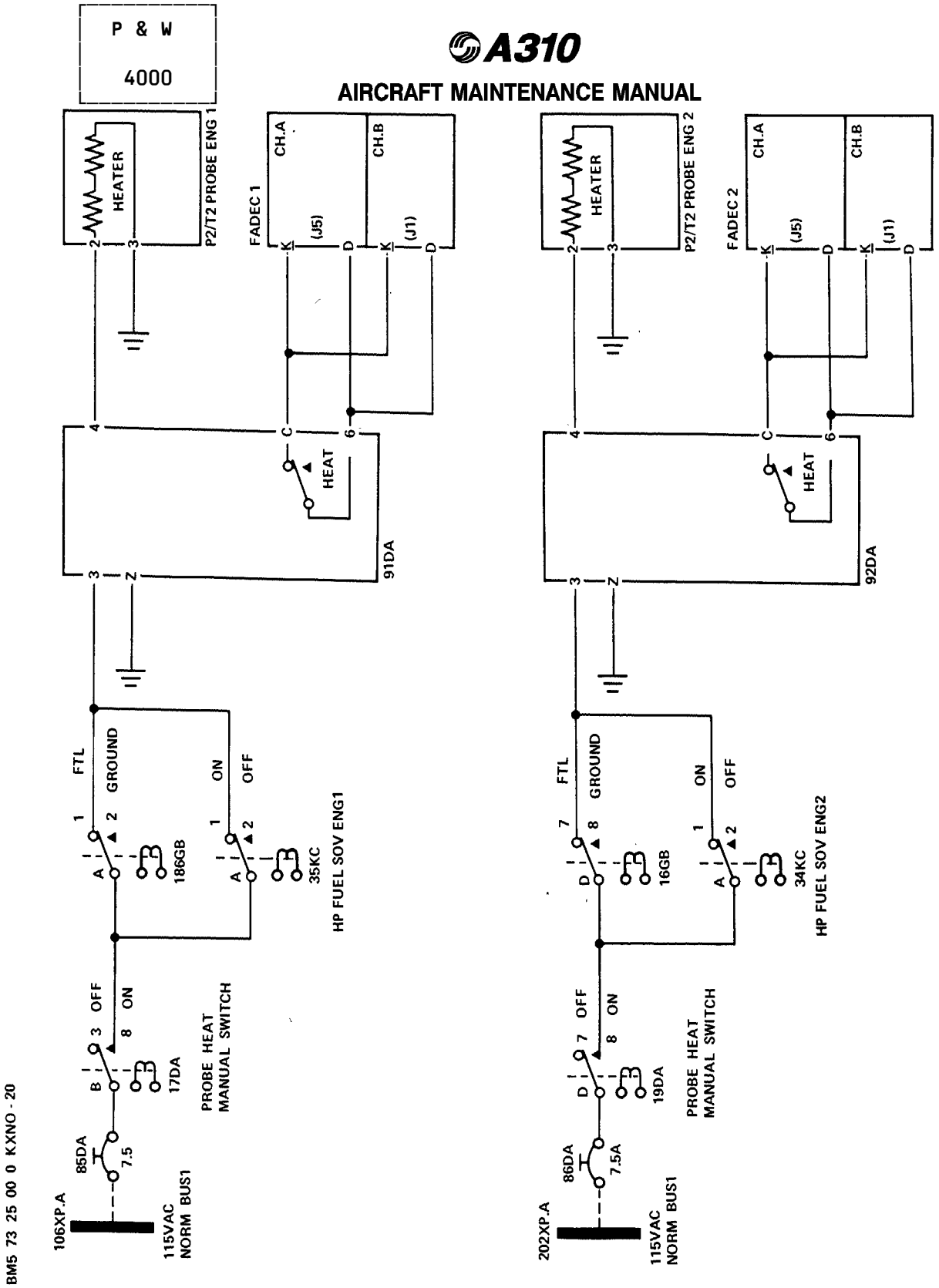
**ON A/C 101-200,



Performance Solenoids Power Supply - Engine 1/2
Figure 060



Performance Solenoids Power Supply - Engine 1/2
Figure 061



P2/T2 Power Supply
Figure 062

G. N1 and N2 Indication Interface

(1)Low compressor rotor speed, N1.

(Ref. Fig. 063)

The analog low rotor speed signal is provided through Channel B of the FADEC. A dual element N1 sensor mounted in the intermediate case, sensing a 60 tooth wheel on the lows rotor shaft provides a signal to each channel.

The FADEC actively buffers the signal provided for airframe interfacing.

N1 characteristics : 100 % = 3600 RPM
Redline = 111.4 % RPM = 4012 RPM

(2)High compressor rotor speed, N2.

(Ref. Fig. 064)

The analog high rotor speed signal is provided by a separate speed signal winding in the permanent magnet alternator which is gearbox mounted and driven. The PMA provides each channel of the FADEC with a three phase power source which the FADEC also uses for its N2 signal input.

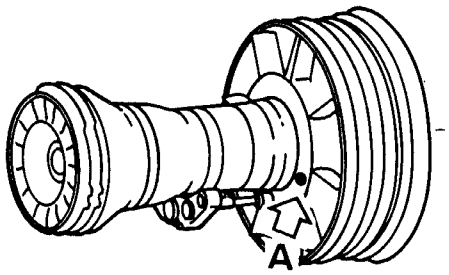
N2 characteristics : 100 % = 9900 RPM
Redline = 104 % RPM = 10300 RPM

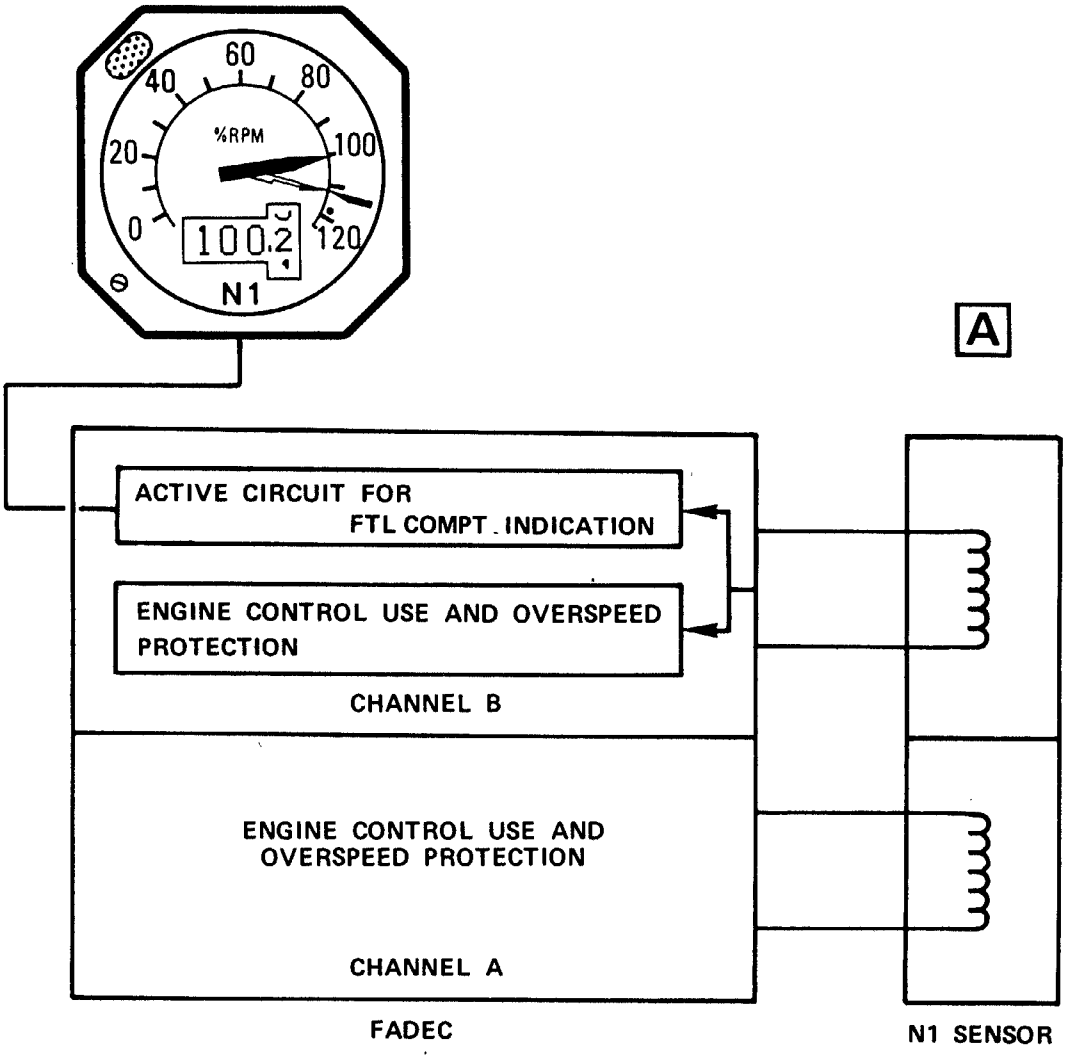
**ON A/C 101-104,

Post SB 72-2032 For A/C 101-104,

N2 characteristics : 100 % = 9900 RPM
Redline = 105,5 % RPM = 10450 RPM

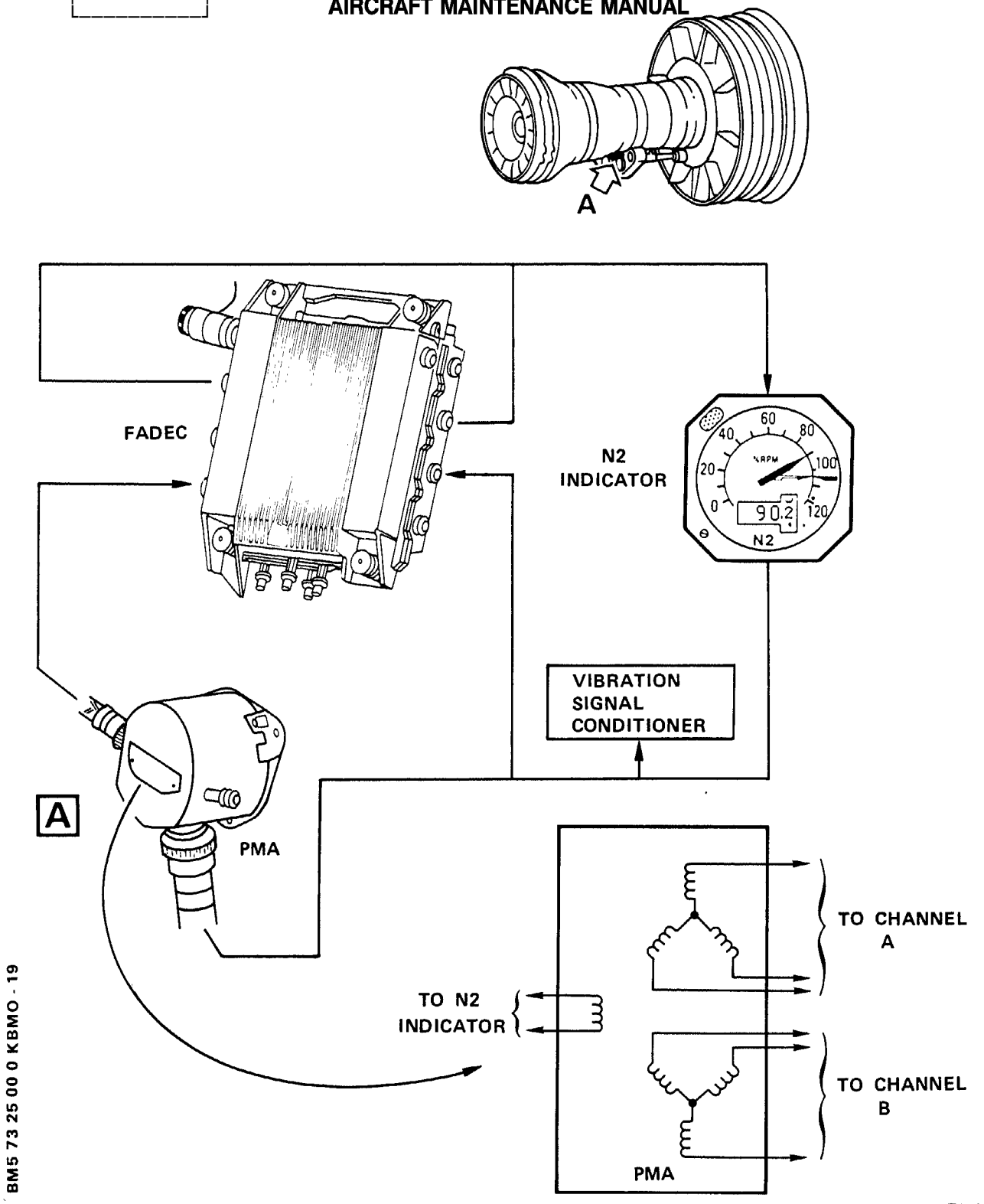
**ON A/C 101-200,





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N1 Indication
Figure 063



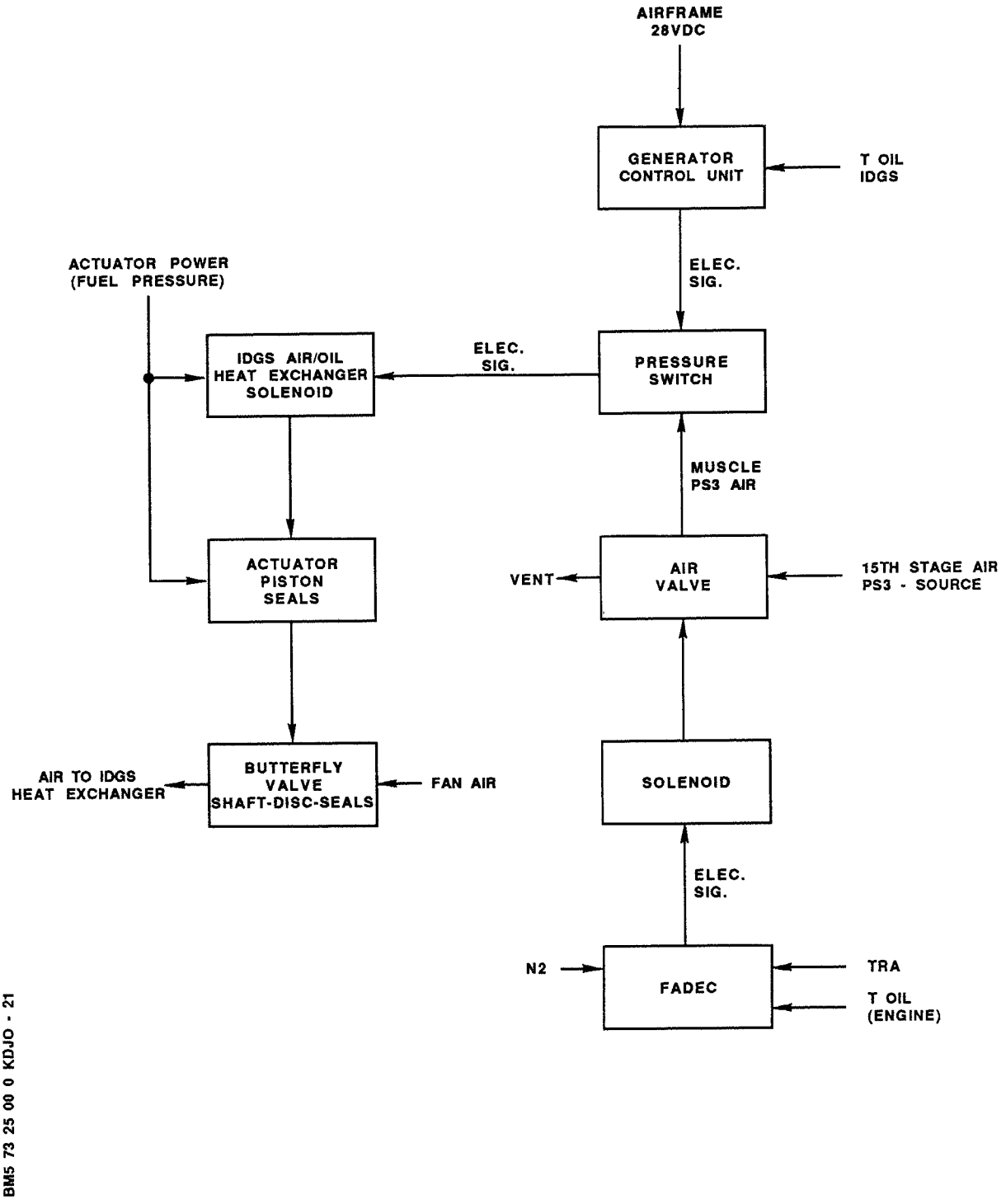
N2 Indication
Figure 064

H. FADEC Interface with the GCU (IDG Air/Oil Cooling)
(Ref. Fig. 065, 066, 067)
(Ref. Fig. 068)
The IDG air/oil heat exchanger override control system allows the FADEC to override the normal action of the GCU and open the IDG air/oil heat exchanger valve to cool the IDG oil thus preventing excessive IDG oil heat rejection to the engine fuel heating system. The override system consists of a FADEC commanded dual coil solenoid and a pneumatically operated pressure switch (using compressor exit pressure PS3 as muscle) in series with the 28VDC going to the IDG air/oil heat exchanger valve solenoid.
Under normal conditions, the GCU controls the position of the IDG air/oil heat exchanger valve. However, if the FADEC senses engine oil temperature above 160°C or N2 speed less than 7200 rpm, the FADEC de-energizes the IDG oil cooling override solenoid, venting the PS3 pressure from the pressure switch causing the pressure switch to open. This opens the GCU electrical circuit to the IDG air/oil heat exchanger valve solenoids, causing the butterfly discs to open. Opening the valve cools the oil and reduces the heat rejection to the fuel through the IDG portion of the fuel-oil cooler.
The IDG air/oil heat exchanger valve is similar to the engine air/oil heat exchanger valve except it is a dual coil solenoid operated two position valve without position feedback to the FADEC. Loss of electrical signal to the solenoid or hydraulic pressure will cause the spring-loaded piston to open the butterfly discs.
Loss of electrical power to the override solenoid will block PS3 pressure and vent the pressure to the normally open pressure switch opening the contacts and causing the IDG air/oil heat exchanger valve to open.

Block Diagram

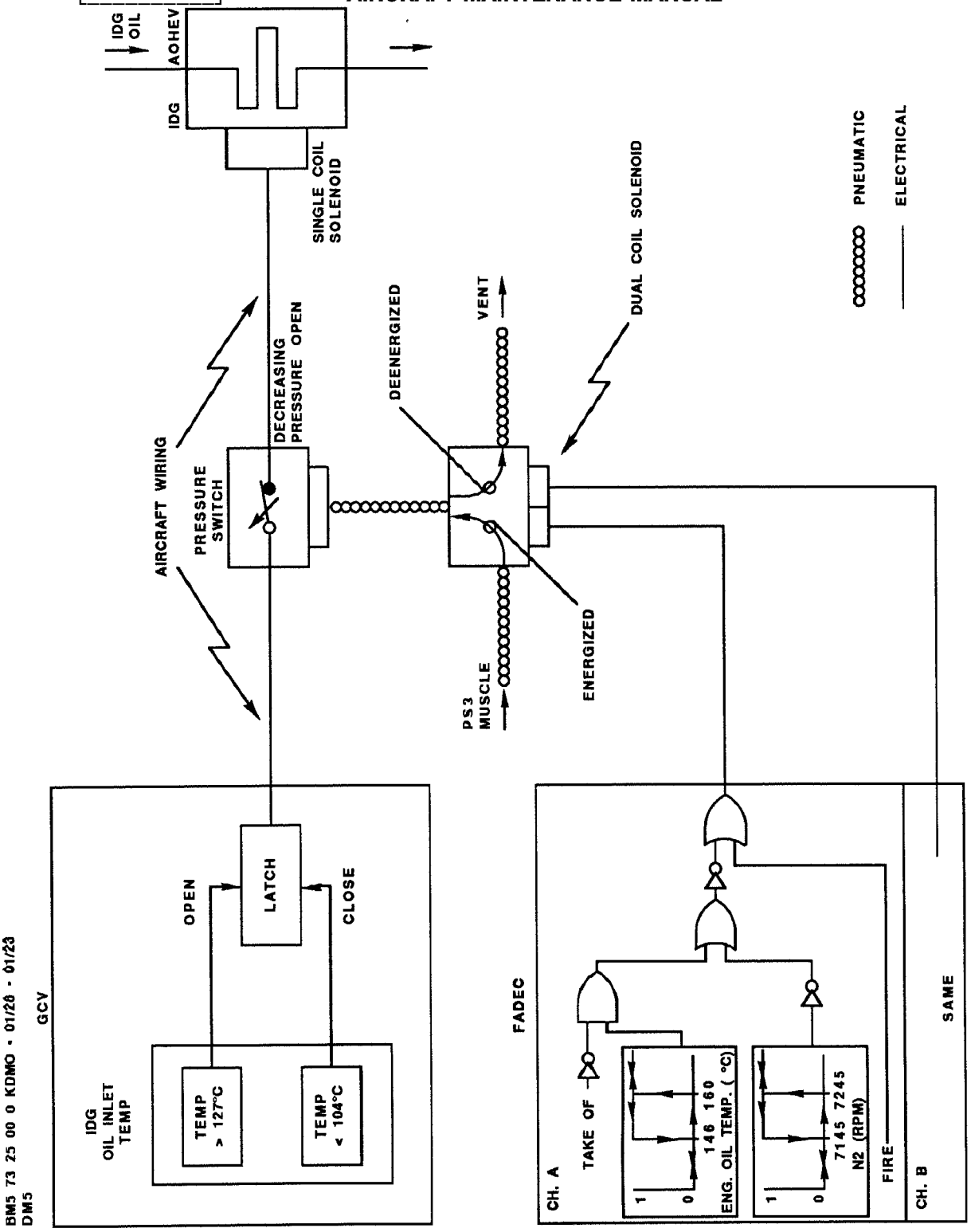
I. FADEC Digital Data Bus Outputs
(1)General
Each FADEC channel sends data to aircraft receivers on a digital data bus, conforming to the ARINC 429.
The information contained on FADEC output data busses include the following general items :
- engine rating parameter information,
- parameters used for engine control,
- FADEC system status information,
- FADEC system maintenance data,
- Engine condition monitoring parameters.

(2)Receivers (Ref. Fig. 069)
(3)Output bus characteristics
The main characteristics of the FADEC output data busses are as follows :
- The transmission is continuous in normal operation on each bus regardless of which channel is in control.
- The data transmission is inhibited in a channel when the processor in that channel is not functioning and during channel initialization.
- Channel switchover does not affect the output data of the FADEC with the exception of the status indication for the channel in control.

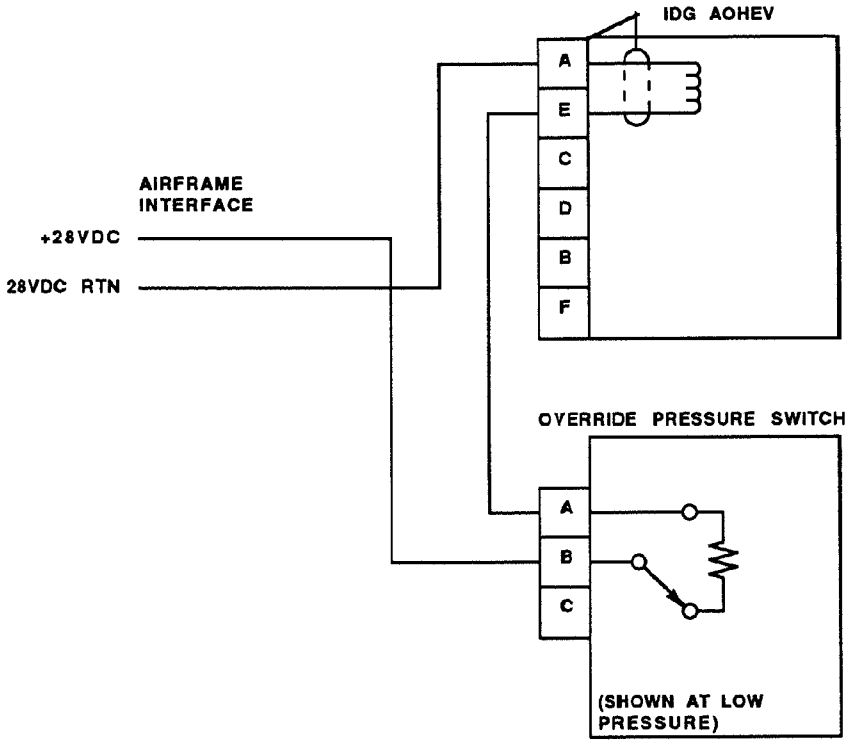


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IDGS Air/Oil Heat Exchanger Valve Override Functional
Figure 065

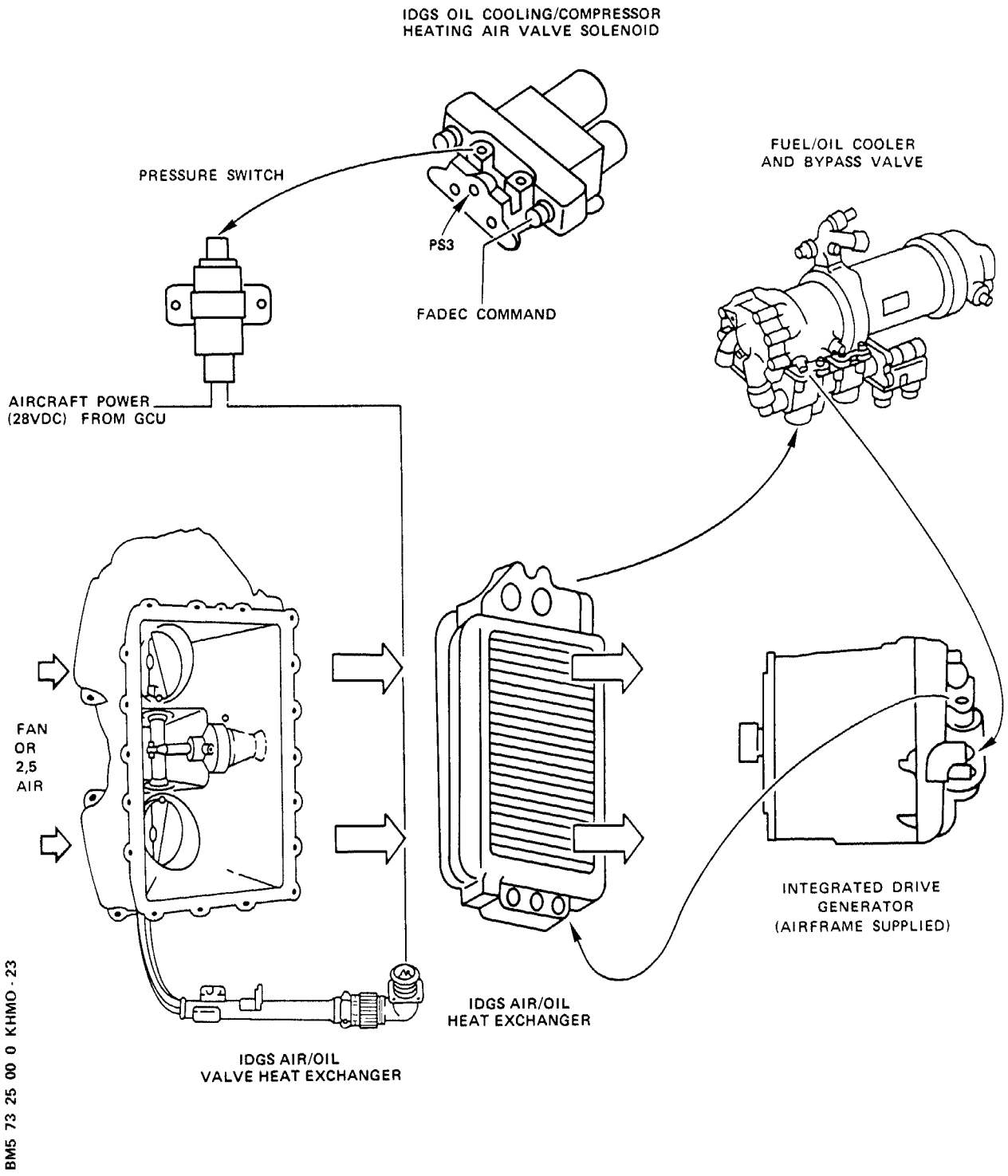


IDG Air/Oil Heat Exchanger Valve Override
Figure 066



BM5 73 25 00 0 KFMO - 01/28 - 01/23
DM5

IDG Air/Oil Heat Exchanger Valve/Pressure Switch Wiring
Figure 067



IDG Oil Cooling Components
Figure 068

- The parameter values outputed by the two channels are normally the same within the tolerance of the redundant sensors.
- The discretes reflect the status of each channel.

(4)Bus contents

Each channel of the FADEC transmits the following data :

(a)Parametric data

See detailed list in table 010

(b)Status and maintenance data :

Octal labels 270-274-050 (status words), 350-354 (maintenance words)
Signal format Discrete
Max. Transmit Interval 200 ms
Bit status "0" is the default state of the discretes
SMM type 5 for 270-274, 8 for 050

The bit assignments of the status and maintenance discrete words are defined in table 011 to 020 and the bit definitions in table 022 to 030.

(c)Status matrix definition :

The status matrix definition is given in table 031.
The discrete data bit patterns transmitted during the ground test in absence of failure is shown in table 032.

Parameter	Octal Label	Max Transmit Interval	Range	Units	Parameter Range	Significant Bits	Approx Resolution	Max Transport Delay	SSM Type
EPRI	340	50	4	---	.5/2.2	13	.0005	30	4
EPRREF	341	50	4	---	.5/2.2	13	.0005	50	7
EPRTO	342	200	4	---	.5/2.2	13	.0005	200	7
N1	346	50	256	%	0/120	14	.015	30	1
N2	344	50	256	%	0/120	14	.015	30	1
N2C25	336	200	128	%	0/125	12	.031	30	1
N2DOT	300	50	16384	RPM/SEC	+16384	14	1.000	--	1
PAMB	114	200	32	PSIA	2/25	14	.002	200	2
P2	131	200	32	PSIA	2/25	13	.004	200	2
PB	264	200	1024	PSIA	2/510	14	.062	200	1
P5	132	200	32	PSIA	2/26.5	14	.002	200	1
T2	130	200	128	°C	-80/90	11	.062	200	2
T3	265	200	1024	°C	-80/500	12	.250	200	1
TF	115	200	512	°C	-60/300	11	.250	200	1
TOIL	316	200	2048	°C	-50.9/400	12	.500	200	1
T5	345	200	2048	°C	-80/1000	12	.500	200	1
TRA	133	200	180	DEGREES	0/90	12	.050	50	1
RUACT	301	100	128	---	0/128	14	.004	200	6
WFRLRQ	334	200	32768	PPH	300/28000	12	8.000	200	5
SVA	325	200	128	% Op.	-5/105	12	.031	200	1
TCC	331	200	128	% Op.	-5/105	12	.031	200	1
AOHE	332	200	128	% Op.	-5/102	12	.031	200	1
B25	335	200	128	% Op.	-5/102	12	.031	200	1
REV	137	200	128	% Dep.	-4/106	12	.031	50	1
FLDEL	302	200	32768	---	0/32768	15	1.000	200	9
CJC	320	200	512	°C	-80/260	11	0.250	200	2

Para-meter	Octal Label	Max Transmit Interval	Range	Units	Parameter Range	Signi-ficant Bits	Approx Reso-lution	Max Transport Delay	SSM Type

PARAMETER DESCRIPTION

EPRI = EPR Actual
EPRTO = Max Available EPR
N2 = High Rotor Speed
N2DOT = N2 Derivative
P2 = Total Inlet Pressure
P5 = Exhaust Gas Pressure
T3 = Compressor Exit Temp
TOIL = Main Oil Temp
TENV = FADEC Environmental Temp
RUACT = Ratio Units (Wf/Pb)
SVA = Stator Vane Actuator FB
AOHE = Air/Oil Heat Exchanger FB
REV = Reverser Position FB
EPRREF = EPR Command
N1 = Low Rotor Speed
N2C25 = Corrected N2 (Sta2.5)
PAMB = Ambient Pressure
PB = Burner Pressure
T2 = Total Inlet Temp
TF = Fuel Temp
T5 = Exhaust Gas Temp
TRA = Throttle Resolver Angle
WFRLRQ = Fuel Flow Request
TCC = Turbine Case Cooling FB
B25 = 2.5 Bleed Actuator FB
FLDEL = Delta Flight Leg
CJC = Cold Junction Compensation

Arinc Output of FADEC - 131 - Parametric Data
Table 010

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label		X
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	GTP ON	ON	OFF
15	OVERSPEED SOL	ON	OFF
16	CH SELECT MODE (AUTO/DEP STATUS)	DEPWR	AUTO
17	AUTO CH TRANSFER	XFER	
18	ALTERNATE MODE	ENGAGED	NOT ENGAGED
19	THRUST LIMITED BY REV POS	LIMITED	NOT LIMITED
20	CHANNEL IN CONTROL	INCON	NOT CONTROLLING
21	SPARE		X
22	OTHER CHANNEL DISPATCH STATUS	OPERATIONAL	NOT AVAIL.
23	CHANNEL DISPATCH STATUS	OPERATIONAL	NOT AVAIL.

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
24	Reserved	X	
25	Reserved	X	
26	ALTERNATE MODE MANUALLY SELECTED	SELECTED	NOT SELECTED
27	CHANNEL IDENTIFICATION	CHANNEL A	CHANNEL B
28	PROBE HEAT ON (Ref. NOTE)	ON	OFF
29	BUMP SELECTED (OBTIONAL) (Ref. NOTE)	SELECTED	NOT SELECTED
30	SSM		
31	SSM		
32	Parity (ODD)		

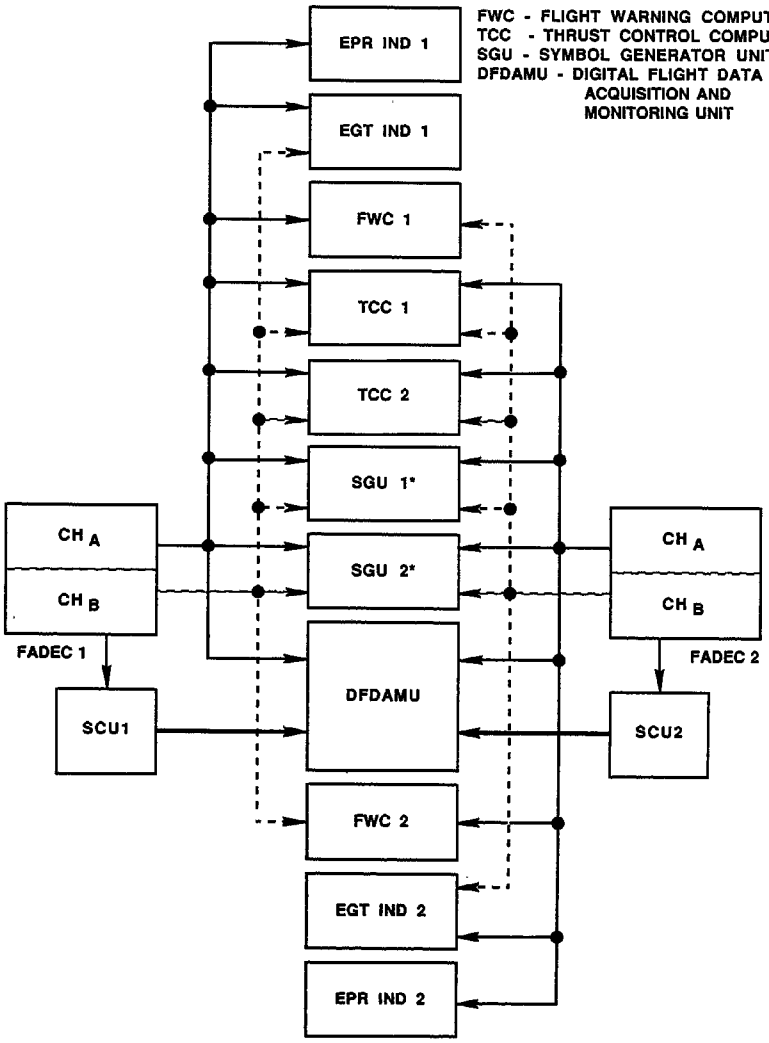
NOTE : Local channel data when in ground test configuration, otherwise represents the selected position.

FADECs Status Word No.1
Label 270
Table 011

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label		X
8	Label	X	
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	TCA SOLENOID	ON	OFF
15	TRC SOLENOID	ON	OFF
16	FOC BYPASS VALVE SOLENOID	ON	OFF
17	IDG O/R SOLENOID	ON	OFF
18	SPARE		X
19	START BLEED SOL.	ON	OFF
20	STABILITY BLEED SOLENOID	ON	OFF
21	ENGINE RATING CODE 1 -		
22	ENGINE RATING CODE 2 |	See Appendix IV	
23	ENGINE RATING CODE 3 |	for definition	
24	ENGINE RATING CODE 4 -		
25	LOOPNO (LSB) -		
26	LOOPNO (BIT 2) |	See Appendix IV	

BIT	FUNCTION	BIT STATUS 1----------0
27	LOOPNO (BIT 3)	for definition
28	LOOPNO (BIT 4)	
29	LOOPNO (MSB)	
30	SSM	
31	SSM	
32	Parity (ODD)	

FADECs Status Word No.2
Label 271
Table 012



REMARKS : 1) - TCC 2.
2) - SGU'S ARE CONNECTED TO FADEC BUSSES ON GROUND ONLY FOR GROUND TEST PURPOSE.

BM5 73 25 00 0 KKVO - 00

FADEC Bus Receivers
Figure 069

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label	X	
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	OVERSPEED SYSTEM FAIL DETECTED	FAILED	OK
15	SPARE		X
16	TCC VALVE STUCK	FAILED	OK
17	OIL COOL/FUEL HEAT SYS FAIL	FAILED	OK
18	SPARE		X
19	SPARE		X
20	SVA SYS FAIL	FAILED	OK
21	STABILITY BLEED STATUS	FAILED	OK
22	START BLEED STATUS	FAILED	OK
23	2.5 BLEED STATUS	FAILED	OK
24	2.5 BLEED STATUS 2 POSITION MODE	2-POSITION	
25	SURGE DETECTED	SURGE	NO
26	FOD DET	FOD	NO
27	REVERSER STATUS	FAILED	OK
28	SPARE		X
29	POWER SOURCE STATUS	SCU	PMA
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Status Word No.3
Label 272
Table 013

R **ON A/C 101-104,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label	X	
8	Label	X	
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	N1 REDLINE - AT OR ABOVE	YES	NO
15	N2 REDLINE - AT OR ABOVE	YES	NO
16	EGT REDLINE - AT OR ABOVE	YES	NO
17	RESERVED		X
18	RESERVED		X
19	SPARE		X
20	SPARE		X
21	OIL TEMP REDLINE	AT OR ABOVE	BELOW
22	OIL TEMP AMBER BAND	IN AMBER BAND	NOT IN BAND
23	OIL TEMP BELOW MIN	BELOW MIN	NO
24	SPARE		X
25	EEC TEMP STATUS	OVER TEMP	NO
26	SPARE		X
27	GROUND ACTUATOR TEST ABORTED	ABORTED	NOT ABORTED
28	GROUND ACTUATOR TEST IN PROGRESS	IN PROGRESS	NOT IN PROGRESS
29	GROUND ACTUATOR TEST INHIBITED	INHIBITED	NOT INHIBITED
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Status Word No.4
Label 273
Table 014

R **ON A/C 105-200,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label		X
7	Label	X	
8	Label	X	
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	N1 REDLINE - AT OR ABOVE	YES	NO
15	N2 REDLINE - AT OR ABOVE	YES	NO
16	EGT REDLINE - AT OR ABOVE	YES	NO
17	RESERVED		X
18	RESERVED		X
19	SPARE		X
R 20	SLOW START	X	
21	OIL TEMP REDLINE	AT OR ABOVE	BELOW
22	OIL TEMP AMBER BAND	IN AMBER BAND	NOT IN BAND
23	OIL TEMP BELOW MIN	BELOW MIN	NO
24	SPARE		X
25	EEC TEMP STATUS	OVER TEMP	NO
26	SPARE		X
27	GROUND ACTUATOR TEST ABORTED	ABORTED	NOT ABORTED
28	GROUND ACTUATOR TEST IN PROGRESS	IN PROGRESS	NOT IN PROGRESS
29	GROUND ACTUATOR TEST INHIBITED	INHIBITED	NOT INHIBITED
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Status Word No.4
Label 273
Table 014

R **ON A/C 101-200,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label		X
3	Label	X	
4	Label	X	
5	Label	X	
6	Label	X	
7	Label		X
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	FIRE DISCRETE (Ref. NOTE)	CLOSED	OPEN
15	RESET DISCRETE (Ref. NOTE)	OPEN	CLOSED
16	MAINTENANCE MODE DISCRETE (Ref. NOTE)	CLOSED	OPEN
17	SPARE		X
18	SPARE		X
19	ENG AT TAKE-OFF POWER	YES	NO
20	ENG RUNNING	YES	NO
21	ENG FLIGHT IDLE SEL	YES	NO
22	TRA BETWEEN 30 AND 44 DEGREES	YES	NO
23	TRA CROSSCHECK FAILURE	YES	NO
24	TRA FAILSAFED	YES	NO
25	TRA FROZEN	YES	NO
26	REV INADVERTENTLY DEPLOYED	YES	NO
27	SPARE		X
28	SPARE		X
29	SPARE		X
30	SSM		
31	SSM		
32	Parity (ODD)		

NOTE : Local channel data when in ground Test configuration, otherwise represents selected position.

FADECs Status Word No.5
Label 274
Table 015

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label		X
2	Label		X
3	Label	X	
4	Label		X
5	Label	X	
6	Label		X
7	Label		X
8	Label		X
9	SDI		X
10	SDI		X
11	BUMP #		
12	BUMP #		
13	BUMP #	FORMAT IS BCD ;	
14	BUMP #	BIT PATTERNS	
15	PACKAGE #	ARE DEFINED IN	
16	PACKAGE #	APPENDIX V.	
17	PACKAGE #		
18	PACKAGE #		
19	RATING (HUNDREDS)		
20	RATING (HUNDREDS)		
21	RATING (HUNDREDS)		
22	RATING (HUNDREDS)		
23	RATING (THOUSANDS)		
24	RATING (THOUSANDS)		
25	RATING (THOUSANDS)		
26	RATING (THOUSANDS)		
27	RATING (TEN THOUSANDS)		
28	RATING (TEN THOUSANDS)		
29	RATING (TEN THOUSANDS)		
30	SSM		
31	SSM		
32	PARITY (ODD)		

NOTE : The Thrust Control Computer does not use this, but does use label 271 bits 21 through 24 to determine the rating selected by the EEC.

FADECs Status Word No. 6
Label 050
Table 016

BIT	FUNCTION		BIT STATUS 1	BIT STATUS 0
1	Label		X	
2	Label			X
3	Label		X	
4	Label			X
5	Label			X
6	Label		X	
7	Label		X	
8	Label			X
9	SDI			
10	SDI			
11	PAD			
12	PAD			X
13	PAD			X
14	DEMSEL (LSB)------			
15	DEMSEL	SELECTED DEM		
16	DEMSEL	(BINARY		
		(FORMAT)		
17	DEMSEL			
18	DEMSEL			
19	DEMSEL (MSB)------			
20	DEM STATUS		FAULT	OK
21	EPR DELTA---------	EPR MODIFIER/		
22	EPR DELTA	CLASS		
23	EPR DELTA			
24	EPR DELTA---------			
25	SPARE			
26	SPARE			
27	SPARE			
28	SPARE			
29	GROUND TEST CONFIGURATION		GROUND TEST	NOT GROUND TEST
30	SSM			
31	SSM			
32	PARITY (ODD)			

* Always represents local channel data

FADECs Status Word No. 7
Label 146
Table 016A

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
5	Label	X	
6	Label		X
7	Label		X
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	FADEC CHANNEL FAULT	FAULT	OK
15	FADEC UNIT FAULT	FAULT	OK
16	FAULT LEVEL A	FAULT	OK
17	FAULT LEVEL B	FAULT	OK
18	FAULT LEVEL C	FAULT	OK
19	GROUND ACTUATOR TEST	PASS	NO STATUS/FAILED
20	PRESSURE SENSORS DISAGREE	DISAGREEMENT	OK
21	P5 PNEUMATIC LINE	FAULT	OK
22	P2 PNEUMATIC LINE	FAULT	OK
23	EXTERNAL DISCRETES DISAGREE	DISAGREEMENT	OK
24	PROBE HEAT	LOST HEAT	OK
25	SPARE		X
26	DATA ENTRY MODIFIER MISSING OR INVALID	FAULT	OK
27	ADC 1 (LEFT)	FAULT	OK
28	ADC 2 (RIGHT)	FAULT	OK
29	THRUST CONTROL COMPUTER	FAULT	OK
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Maintenance Word No.1
Label 350
Table 017

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X
5	Label	X	
6	Label		X
7	Label		X
8	Label	X	
9	SDI		X

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	FMU T/M W/A	FAULT	OK
15	SVA T/M W/A	FAULT	OK
16	B25 T/M W/A	FAULT	OK
17	TCC T/M W/A	FAULT	OK
18	AOHE T/M W/A	FAULT	OK
19	FMU TRACK CHECK	FAULT	OK
20	SVA TRACK CHECK	FAULT	OK
21	B25 TRACK CHECK	FAULT	OK
22	TCC TRACK CHECK	FAULT	OK
23	AOHE TRACK CHECK	FAULT	OK
24	FMU FEEDBACK	FAULT	OK
25	SVA FEEDBACK	FAULT	OK
26	B25 FEEDBACK	FAULT	OK
27	TCC FEEDBACK	FAULT	OK
28	AOHE FEEDBACK	FAULT	OK
29	FMU OVERSPEED CIRCUIT	FAULT	OK
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs MAINTENANCE Word No.2
Label 351
Table 018

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X
5	Label	X	
6	Label		X
7	Label	X	
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	N1 RANGE	FAULT	OK
15	PMA (N2) RANGE	FAULT	OK
16	SPARE		X
17	T 29 RANGE	FAULT	OK
18	T2 RANGE	FAULT	OK
19	T5 RANGE	FAULT	OK
20	TFUEL RANGE	FAULT	OK
21	TOIL RANGE	FAULT	OK
22	T3 RANGE	FAULT	OK
23	EEC TEMP EXCEEDED 105°C	FAULT	OK
24	T FUEL > 149°C (300°F)	FAULT	OK
25	REVERSER RANGE	FAULT	OK
26	TRA RANGE	FAULT	OK
27	TRA HIGH RANGE	FAULT	OK
28	AOEH FAULT SETS FAULT LEVEL A	FAULT	OK
29	OTHER CHANNEL POWER OUTAGE	OUTAGE	OK
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Maintenance Word No.3
Label 352
Table 019

R **ON A/C 101-104,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X
5	Label	X	
6	Label		X
7	Label	X	
8	Label	X	
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	N1 CROSSCHECK	FAULT	OK
15	PMA (N2) CROSSCHECK	FAULT	OK
16	PMA FAULT	FAULT	OK
17	SPARE		X
18	T2 CROSSCHECK	FAULT	OK
19	T5 CROSSCHECK	FAULT	OK
20	TFUEL CROSSCHECK	FAULT	OK
21	TOIL CROSSCHECK	FAULT	OK
22	T3 CROSSCHECK	FAULT	OK
23	SPARE		X
24	FMU CROSSCHECK	FAULT	OK
25	REVERSER CROSSCHECK	FAULT	OK
26	TRA CROSSCHECK	FAULT	OK
27	PAMB LINE FAULT	FAULT	OK
28	START/TANDEM BLEED FAILED OPEN	FAULT	OK
29	CROSS-LINK FAILURE	FAULT	0
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Maintenance Word No.4
Label 353
Table 020

R **ON A/C 105-200,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X
5	Label	X	
6	Label		X
7	Label	X	
8	Label	X	
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	N1 CROSSCHECK	FAULT	OK
15	PMA (N2) CROSSCHECK	FAULT	OK
R 16	PMA FAULT	FAULT	OK
R 17	TCA FAILED CLOSED	FAULT	OK
18	T2 CROSSCHECK	FAULT	OK
19	T5 CROSSCHECK	FAULT	OK
20	TFUEL CROSSCHECK	FAULT	OK
21	TOIL CROSSCHECK	FAULT	OK
22	T3 CROSSCHECK	FAULT	OK
23	SPARE		X
24	FMU CROSSCHECK	FAULT	OK
25	REVERSER CROSSCHECK	FAULT	OK
26	TRA CROSSCHECK	FAULT	OK
27	PAMB LINE FAULT	FAULT	OK
28	START/TANDEM BLEED FAILED OPEN	FAULT	OK
29	CROSS-LINK FAILURE	FAULT	0
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Maintenance Word No.4
Label 353
Table 020

R **ON A/C 101-200,

BIT	FUNCTION	BIT STATUS 1	BIT STATUS 0
1	Label	X	
2	Label	X	
3	Label	X	
4	Label		X
5	Label	X	
6	Label	X	
7	Label		X
8	Label		X
9	SDI		X
10	SDI		X
11	PAD		X
12	PAD		X
13	PAD		X
14	OVERSPEED SOL W/A	FAULT	OK
15	START BLEED SOL W/A	FAULT	OK
16	STABILITY BLEED SOL W/A	FAULT	OK
17	FUEL/OIL COOLER SOL W/A	FAULT	OK
18	IDG OVERRIDE SOL W/A	FAULT	OK
19	A/C 28 VOLT PERF.SOL.POWER	OUTAGE	OK
20	TRC SOL W/A	FAULT	OK
21	SPARE		X
22	TCA SOL W/A	FAULT	OK
23	SPARE		X
24	PMA SOL CURRENT SENSE RESET	DETECTED	OK
25	ENG SOL CURRENT SENSE RESET	DETECTED	OK
26	SPARE		X
27	MODE INDICATOR W/A	FAULT	OK
28	SPARE		X
29	O/S FAILED LAST SHUTDOWN	FAULT	X
30	SSM		
31	SSM		
32	Parity (ODD)		

FADECs Maintenance Word No.5
Label 354
Table 021

BIT	STATUS WORD BIT DEFINITIONS
14	GTP ON Bit set if Ground Test Power is on. Cleared otherwise.
15	OVERSPEED SOLENOID Bit set if overspeed solenoid has been energized due to threshold exceedances in N1 or N2.
16	CH SEL MODE (AUTO/DEP STATUS) Not incorporated in this part number FADEC.
17	AUTO CH. TRANSFER Bit is set if the FADEC has automatically switched channels.
18	ALTERNATE MODE SEL Bit is set if the channel has reverted to N1 mode due to a combination of faults which prevent operation in the normal EPR mode or if a manual selection of the N1 mode has occurred, cleared otherwise. This bit will not be set in reverse if none of the above condition has occurred.
19	THRUST LIMITED BY REVERSER POSITION Bit is set when the reverser is in transit or is out of position relative to the TRA position input.
20	CHANNEL IN CONTROL Bit is set if the channel is in control, cleared otherwise.
22	OTHER CHANNEL DISPATCH STATUS Bit is set if it is determined that the remote channel has adequate resources to control the engine in a stable manner. Bit is not set if crosstalk is failed.
23	CHANNEL DISPATCH STATUS Same as Label 270 bit No.22 except pertains to the local channel.
*	Bit numbers from 14 to 29 which are not listed are spares.
26	ALTERNATE MODE MANUALLY SELECTED Bit is set if the alternate (N1) mode has been manually selected by the crew.
27	CHANNEL ID Bit identifies the channel as follows: Channel A if bit set. Channel B if bit cleared.
28	PROBE HEAT Bit is set if the inlet probe heat is on.

BIT	STATUS WORD BIT DEFINITIONS
29	BUMP RATING SELECTED (OPTIONAL) Bit is set if the bump rating has been selected

270 Status Word Bit Definitions
Table 022

BIT	STATUS WORD BIT DEFINITIONS
14	TCA SOLENOID Bit is set if the turbine (blade and vane) cooling air solenoid is energized, 12th stage turbine (blade and vane) cooling air valve commanded closed.
15	TRC SOLENOID Bit is set if the rotor heating control solenoid is energized, 9th stage rotor cooling air valve commanded closed.
16	OIL BYPASS SOLENOID Bit is set is the Oil Bypass Solenoid is energized, fuel/oil cooler oil bypass valve commanded open.
17	IDG O/R SOL Bit is set if the IDG Override solenoid is energized. IDG air/oil heat exchanger valve not commanded open by the FADEC.
19	START BLEED SOL Bit is set if the 9th stage start bleed solenoid is energized, start bleed valve commanded to the open position.
20	STABILITY BLEED SOL Bit is set if the 9th stage stability bleed solenoid is energized, stability bleed valve commanded to the closed position.
21-24	ENGINE RATING CODE * Bits are set to indicate the rating selected through the DEM.

BIT		24	23	22	21
Model	Rating				
INVALID		0	0	0	0
4156	1	0	0	0	1
4152	2	0	0	1	0
4158	3	0	0	1	1
4156	4	0	1	0	0
4156A	5	0	1	0	1
4158	6	0	1	1	0
4156	7	0	1	1	1

BIT	STATUS WORD BIT DEFINITIONS				
4152	8	1	0	0	0

* Only ratings 1, 2, 3 and 5 are recognized by the Thrust Control Computer.

BIT	STATUS WORD BIT DEFINITIONS
25-29	LOOPNO These bits indicate which fuel error term is being used to control fuel flow. LOOPNO is determined by comparing the selected error term to the error term calculated for each loop.

BIT					LOOP
29	28	27	26	25	
0	0	0	0	0	N0 Loop Selected
0	0	0	0	1	N1 Bottoming Loop
0	0	0	1	0	N1 Topping Loop
0	0	0	1	1	N2 Idle Loop
0	0	1	0	0	N2 Topping Loop
0	0	1	0	1	PB Topping Loop
0	0	1	1	0	PB Bottoming Loop
0	0	1	1	1	EPR Loop
0	1	0	0	0	N2DOT Accel. Schedule Limiting
0	1	0	0	1	N2DOT Decel. Schedule Limiting
0	1	0	1	0	Minimum Ratio Unit Limiting
0	1	0	1	1	N1 Loop
-	-	-	-	-	Not Defined
0	1	1	0	1	Min. Fuel Flow Limiting
0	1	1	1	0	Start Schedule Governing
0	1	1	1	1	Wf Rate Limit

271 Status Word Bit Definitions
Table 023

BIT	STATUS WORD BIT DEFINITIONS
14	OVERSPEED SYSTEM FAIL DETECTED Bit is set if an overspeed system failure has been detected by the FADEC. Overspeed system tests are accomplished during spool up and spool down. Bit is also set if an overspeed occurs and fuel flow valve has not been driven to min flow position within a pre-determined time.
16	TCC VALVE STUCK Bit is set is the turbine case cooling valve has failed in the non-failsafe (open) position. Fan discharge turbine case cooling air on.
17	OIL COOL/FUEL SYS. FAIL Bit is set if the modulated air/oil cooler valve is in the open position due to a failure which prevents proper scheduling. The following faults will set the bit : - Both TFUEL inputs failed - AOC feedback failed - AOC W/A fault - Track check has occured and (AOC position-requested position) > 15°RVT
20	SVA SYS FAIL Bit is set if the SVA system is inoperative.
21	STABILITY BLEED STATUS Bit is set if the stability bleed valve solenoid is inoperative.
22	START BLEED STATUS Bit is set if the start bleed valve solenoid is inoperative.
23	2.5 BLEED STATUS Bit is set if the 2.5 bleed system is inoperative.
24	2.5 BLEED 2 POS MODE Bit is set if the 2.5 bleed has reverted to the non-modulated OPEN/CLOSED control mode. Cleared otherwise.
25	SURGE DETECTED Bit is set if a surge has been detected. Possible surges are detected using Pb rate of change or P5 rate of change.
26	FOD DETECTED Bit is set if foreign object damage is detected by the FADEC.
27	REVERSER STATUS Bit is set if the channel is incapable of sensing reverser position or if the reverser has inadvertently stowed or deployed.
29	POWER SOURCE STATUS Bit is set to indicate that FADEC power supply is performed via SCU instead of PMA.

272 Status Word Bit Definitions
Table 024

**ON A/C 101-104,

BIT	STATUS WORD BIT DEFINITIONS
14	N1 REDLINE - AT OR ABOVE Bit is set if N1 RPM is greater than or equal to the N1 redline.
15	N2 REDLINE - AT OR ABOVE Bit is set if N2 RPM is greater than or equal to the N2 redline.
16	EGT REDLINE - AT OR ABOVE Bit is set is the exhaust gas temperature has attained or exceeded the redline value.
17	Reserved
18	Reserved
21	TOIL REDLINE - AT OR ABOVE Bit is set to indicate that the engine oil temperature is at or above the redline value. Redline value is set to 177°C.
22	TOIL AMBER BAND Bit is set to indicate that the engine oil temperature is over the amber level but less than the redline value. The low end of the amber band is set for 163°C.
23	OIL TEMP BELOW MIN Bit is set to indicate that the oil temperature is below the minimum value (50°C) for take-off.
25	FADEC TEMP STATUS (RED) Bit is set to indicate that the FADEC's temperature has attained or exceeded 105°C.
27	GROUND ACTUATOR TEST ABORTED Bit set indicates that the ground actuator test was aborted in the local channel.
28	GROUND ACTUATOR TEST IN PROGRESS Bit set indicates that the ground actuator test is in progress in the local channel.
29	GROUND ACTUATOR TEST INHIBITED Bit set indicates that the ground actuator test is inhibited. Test is inhibited whenever the enabling conditions are not met.

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**ON A/C 105-200,

BIT	STATUS WORD BIT DEFINITIONS
14	N1 REDLINE - AT OR ABOVE Bit is set if N1 RPM is greater than or equal to the N1 redline.
15	N2 REDLINE - AT OR ABOVE Bit is set if N2 RPM is greater than or equal to the N2 redline.
16	EGT REDLINE - AT OR ABOVE Bit is set is the exhaust gas temperature has attained or exceeded the redline value.
17	Reserved
18	Reserved
20	SLOW START Bit is set if a slow start is detected.
21	TOIL REDLINE - AT OR ABOVE Bit is set to indicate that the engine oil temperature is at or above the redline value. Redline value is set to 177°C.
22	TOIL AMBER BAND Bit is set to indicate that the engine oil temperature is over the amber level but less than the redline value. The low end of the amber band is set for 163°C.
23	OIL TEMP BELOW MIN Bit is set to indicate that the oil temperature is below the minimum value (50°C) for take-off.
25	FADEC TEMP STATUS (RED) Bit is set to indicate that the FADEC's temperature has attained or exceeded 105°C.
27	GROUND ACTUATOR TEST ABORTED Bit set indicates that the ground actuator test was aborted in the local channel.
28	GROUND ACTUATOR TEST IN PROGRESS Bit set indicates that the ground actuator test is in progress in the local channel.
29	GROUND ACTUATOR TEST INHIBITED Bit set indicates that the ground actuator test is inhibited. Test is inhibited whenever the enabling conditions are not met.

**ON A/C 101-200,

BIT	STATUS WORD BIT DEFINITIONS
14	FIRE DISCRETE CONTACT Bit represents the selected position of the fire discrete contact except when in ground test configuration when it represents the local channel input. Bit set indicates the fire discrete contact is closed.
15	RESET DISCRETE CONTACT Bit represents the selected position of the Reset discrete contact except when in ground test configuration when it represents the local channel input. Bit set indicates the Reset discrete contact is open.
16	MAINTENANCE DISCRETE CONTACT Same as bit 14 but applied to the maintenance discrete.
17	Spare
18	Spare
19	ENGINE AT TAKE-OFF POWER Bit is set to indicate that the engine is at take-off power.
20	ENGINE RUNNING Bit is set to indicate that the engine is operating. Bit is cleared if the engine is shutdown normally or if shutdown occurs due to an engine system failure. Engine is considered running if N2>5000 RPM.
21	ENGINE FLIGHT IDLE SEL Bit is set to indicate that flight idle has been selected by FADEC logic.
22	TRA BETWEEN 30 AND 44 DEGREES (TRA within proper shutdown zone) Bit is set to indicate when the throtlle resolver angle is at a proper shutdown position.
23	TRA CROSSCHECK FAILURE DETECTED Bit is set if the local and remote TRA inputs disagree by more than 1.5 degrees. Fault accommodation is in line and occurs before bit is set.
24	TRA FAILSAFED Bit is set if the failsafe (Idle) TRA has been selected.
25	TRA FROZEN Bit is set if no healthy TRA is available and the last healthy value has been selected.
26	REVERSER INADVERTENTLY DEPLOYED Bit is set if the reverser is in the deployed position (>10%) while

BIT	STATUS WORD BIT DEFINITIONS
	the TRA indicates forward thrust. Bit is used to disengage the auto-throttle system is fault occurs.

274 Status Word Bit Definitions
Table 026

BIT	STATUS WORD BIT DEFINITIONS
11-14	BUMP NUMBER (Ref. NOTE) BCD representation of the bump rating selected MSB = 14
15-18	PACKAGE NUMBER (Ref. NOTE) BCD representation of the package number selected. MSB = 18
19-22	RATING (Ref. NOTE) BCD representation of the rating hundreds digit. MSB = 22
23-26	RATING (Ref. NOTE) BCD representation of the rating thousands digit. MSB = 26
27-29	RATING (Ref. NOTE) BCD representation of the rating ten thousands digit. MSB = 29
	NOTE : The label 050 bit configuration for the current rating structure is as follows :

LABEL 050 BITS

RATING	29-27	26-23	22-19	18-15	14-11	MODEL
1	5	6	0	+	+	4156
2	5	2	0	+	+	4152
3	5	8	0	+	+	4158

+ There are 63 DEM Selectable Configurations, the package and bump can very between locations.

050 Status Word Bit Definition
Table 027

BIT	MAINTENANCE WORD DEFINITIONS
14	FADEC CHANNEL FAULT Bit is set if a fault exist within the local channel.
15	FADEC UNIT FAULT Bit is set if a fault exists within the FADEC.
15	Fault Level A The bit is set if channel is not dispatchable.
17	Fault Level B This bit is set if a time limited fault is identified.
18	Fault Level C This bit is set if a time limited minor fault is identified.
19	GROUND ACTUATOR TEST PASS Bit set indicates the ground actuator test has been completed with no faults in the local channel. Bit cleared indicates that the test did not pass or has not been run.
20	PRESSURE SENSORS DISAGREE Bit is set if any pressure sensor comparison made during the pressure sensor static test is not within tolerance.
21	P5 PNEUMATIC LINE Bit is set if it is probable that the P5 pneumatic line has failed. The FADEC will set this bit if neither channels interface nor range fail flags are set, but both channels inputs disagree with a valid referee.
22	P2 PNEUMATIC LINE Bit is set to indicate that it is probable that the P2 probe is iced or the P2 line has failed. The bit is set in the following cases : - MN > .21 air data agree, at least one has probe heat and neither agrees with the engine probe. - MN > .21 neither air data PT is valid (no probe heat, hard failed or disagrees with probe) and engine probe heat is off. - Engine probe soft-failed with synthesis. Test is performed when synthesis and engine probe are not hardfailed and any of the following are true. - N2 < 55 % - MN < .21 and probe heat is on - Neither ADC input is valid. ADC inputs may be invalid for any of the following reasons :

BIT	MAINTENANCE WORD DEFINITIONS
	- Probe heat off - Disagrees with engine sensed data - Input is hard failed (out of range, not received, bad SSM, parity)
	NOTE : Engine P2 hard failures are included in the unit fault indication label 350, bit 15.
23	EXTERNAL DISCRETES DISAGREE Bit is set if the local and crosstalked values of any of the following external discretes disagree (failsafe values are used for those discretes which disagree). The cross-checked discretes and their failsafe values are as follows : Power Source : SCU Probe Heat : Off Fire : No Fire Maintenance (BITE) : Off Mode select : N1 mode Reset : No reset Bump : No Bump If crosstalk is not healthy, or a remote input discrete max fault exists the cross-check test is ignored and the local input is used. The bit is also set if it is determined that the power source discrete is in the wrong position (not set when ground test power is on with an SCU installed and N2 equal to zero).
24	PROBE HEAT Bit is set if MN >.12 (synthesized WOW=0) or N2 >55 % and the local channels probe heat is off for 5 seconds.
26	DATA ENTRY MODIFIER MISSING OR INVALID Bit is set to indicate the Data Entry Modifier plug is missing or if an invalid state is detected.
27	ADC1 (LEFT) Bit is set if a left air data computer fault exists, set if all of the ADC labels are erroneous for any of the following reasons for greater than 10 seconds : . Range failure . Other than normal SSM . Parity Error . Left ADC dot not received for 10 seconds or if 7 interruptions lasting less than 10 seconds occur. . If all parametric data (T2, P2, Alt) are soft-failed with the engine probes. Bit can be set if in ground test configuration. If not in ground test configuration, bit will not be set until Mach Number exceeds 0.21.

BIT	MAINTENANCE WORD DEFINITIONS
28	ADC2 (RIGHT) Same as bit 27 but applies to the right air data computer.
29	TCC (SERIAL DIGITAL DATA INPUT) This bit is set if it is probable that a TCC link fault has occured and is set if any of the following faults exist for more than 10 seconds : . Parity Error . Not Received . Other than normal SSM The bit will also be set if seven >550 msec outages occur. If in ground test configuration, the bit can be set. If not in ground test configuration, the bit is not set until MN exceeds 0.21 and N2 >5000 rpm.

Maintenance Word No. 1 Octal Label No. 350
Table 028

BIT	MAINTENANCE WORD DEFINITIONS
14	FMU T/M W/A Bit is set to indicate that it is probable that the local channel fuel flow torque motor coil or its related wiring has a circuit fault.
15	SVA T/M W/A Same as bit 14 but applies to the stator vane torque motor.
16	B25 T/M W/A Same as bit 14 but applies to the 2.5 bleed torque motor.
17	TCC T/M W/A Same as bit 14 but applies to the turbine case cooling torque motor.
18	AOHE T/M W/A Same as bit 14 but applies to the air/oil heat exchanger torque motor.
19	FMU TRACK CHECK Bit is set if the actual position of the FMU fuel flow valve is not within a specified tolerance of the commanded position. Steady state tolerance is 8° resolver, approximately 9.3 % of full stroke.
20	SVA TRACK CHECK Same as bit 19 but applies to the SVA position. Steady state tolerance is 0.23 in., approximately 8.7 % of full stroke.
21	B25 TRACK CHECK

BIT	MAINTENANCE WORD DEFINITIONS
	Same as bit 19 but applies to the 2.5 bleed position. Steady state tolerance is 15° RVT, approximately 16 % of full stroke.
22	TCC TRACK CHECK Same as bit 19 but applies to the turbine case cooling actuator position. Steady state tolerance is 0.21 in., approximately 13 % of full stroke.
23	AOHE TRACK CHECK Same as bit 19 but applies to the air/oil cooler valve position. Steady state tolerance is 13,5 RVT, approximately 13 % of full stroke.
24	FMU FEEDBACK Bit is set if the local channels feedback signal is failed due to a range or rate failure, or if it is not within a specified tolerance of a valid synthesized position. Limits are as stated below : RANGE : 1.9 to 88.1° Res. RATE : 500 Deg/Sec TOLERANCE : 8° Res., approximately 8.7 % of full stroke
25	SVA FEEDBACK Same as bit 24 but applies to the SVA position feedback and also includes a crosscheck fault. Limits are as stated below : Range : -.2 to 2.55 Inches Rate : 5 In/Sec Crosscheck : .10 Inches Tolerance : .23 Inches, approximately 8.4 % of full stroke
26	B25 FEEDBACK Same as bit 24 but applies to the 2.5 bleed position feedback and also includes a crosscheck fault. Limits are stated below : Range : -4.16 to 90.28° RVT Rate : 912° RVT/Sec Crosscheck : 9° RVT Tolerance : 15° RVT, approximately 13 % of full stroke
27	TCC FEEDBACK Same as bit 24 but applies to the turbine case cooling position feedback and also includes a crosscheck fault, Limits are as stated belows : Range : -.03 to 1.57 Inches Rate : 2 Inches/Sec Crosscheck : .10 Inches Tolerance : .21 Inches, approximately 13 % of full stroke

BIT	MAINTENANCE WORD DEFINITIONS
28	AOHE FEEDBACK Same as bit 24 but applies to the air/oil heat exchanger position feedback.
29	FMU OVERSPEED CIRCUIT Bit is set if the overspeed solenoid has failed the spool-down test or if an actual overspeed has been detected and the fuel flow valve is not driven to the minimum flow stop within 0.6 seconds.

Maintenance Word No. 2 Octal Label No. 351
Table 029

**ON A/C 101-104,

BIT	MAINTENANCE WORD DEFINITIONS
14	N1 RANGE Bit is set if the local N1 sensor input is latched failed due to a signal range failure. Limits are as stated below : Range : 200 to 4800 Rate : 4000 RPM/Sec
15	PMA (N2) RANGE The same as bit 14 but applies to the N2 signal. Limits are as stated below : Range : 1000 to 12360 RPM Rate : 4000 RPM/Sec
17	T29 RANGE Bit is set if the local T29 is failed due to a range or rate failure. Limits are as follows : Range : -80° to 100°C Rate : 200°C/Sec
18	T2 RANGE Bit is set if the local T2 is failed due to a range or rate failure. Limits are as stated below : Range : -80 to 90°C Rate : 90°C/Sec
19	T5 RANGE The same as bit 18 but applies to the exhaust gas temperature signal. Limits are as stated below : Range : -80 to 1000°C Rate : 200°C/Sec
20	TFUEL RANGE

BIT	MAINTENANCE WORD DEFINITIONS
	Same as bit 18 but applies to the fuel temperature signal. Limits are as stated below : Range : -50.9 to 300°C Rate : 50°/Sec
21	TOIL RANGE Same as bit 18 but applies to the oil temperature signal. Limits are as stated below : Range : -50.9 to 400°C Rate : 20°C/Sec
22	T3 RANGE Same as bit 18 but applies to the high pressure compressor discharge temperature. Limits are as stated below : Range : -80°C to 1000°C Rate : 200°C/Sec
24	TFUEL HIGH Bit is set if fuel temperature exceeds 149°C (300°F).
25	REVERSER RANGE Same as bit 18 but applies to the reverser position signal. Limits are as stated below : Range : -4 % to 106 % Rate : 2500 %/Sec
26	TRA RANGE Same as bit 18 but applies to the TRA position signal. Limits are as stated below : Range : 4° to 87°Res Rate : 600°Res/Sec
27	TRA HIGH RANGE Bit is set if either the local or cross-talked TRA signal is out of range high. (>86.5°).
28	AOC FAULT SETS FAULT LEVEL A Bit is set if an AOC system fault caused a no dispatch condition.
29	OTHER CHANNEL POWER Bit is set if the local channel determines that the remote channel has lost power. The determination is based on the crosslink and remote channel pressure sensor data.

Maintenance Word No. 3 Octal Label 352
Table 030

**ON A/C 105-200,

BIT	MAINTENANCE WORD DEFINITIONS
14	N1 RANGE Bit is set if the local N1 sensor input is latched failed due to a signal range failure. Limits are as stated below : Range : 200 to 4800 Rate : 4000 RPM/Sec
15	PMA (N2) RANGE The same as bit 14 but applies to the N2 signal. Limits are as stated below : Range : 1000 to 12360 RPM Rate : 4000 RPM/Sec
17	T29 RANGE Bit is set if the local T29 is failed due to a range or rate failure. Limits are as follows : Range : -80° to 100°C Rate : 200°C/Sec
18	T2 RANGE Bit is set if the local T2 is failed due to a range or rate failure. Limits are as stated below : Range : -80 to 90°C Rate : 90°C/Sec
19	T5 RANGE The same as bit 18 but applies to the exhaust gas temperature signal. Limits are as stated below : Range : -80 to 1000°C Rate : 200°C/Sec
20	TFUEL RANGE Same as bit 18 but applies to the fuel temperature signal. Limits are as stated below : Range : -54 to 300°C Rate : 50°/Sec
21	TOIL RANGE Same as bit 18 but applies to the oil temperature signal. Limits are as stated below : Range : -54 to 400°C Rate : 20°C/Sec
22	T3 RANGE

BIT	MAINTENANCE WORD DEFINITIONS
	Same as bit 18 but applies to the high pressure compressor discharge temperature. Limits are as stated below : Range : -80°C to 1000°C Rate : 200°C/Sec
24	TFUEL_HIGH Bit is set if fuel temperature exceeds 149°C (300°F).
25	REVERSER_RANGE Same as bit 18 but applies to the reverser position signal. Limits are as stated below : Range : -4 % to 106 % Rate : 2500 %/Sec
26	TRA_RANGE Same as bit 18 but applies to the TRA position signal. Limits are as stated below : Range : 4° to 87°Res Rate : 600°Res/Sec
27	TRA_HIGH_RANGE Bit is set if either the local or cross-talked TRA signal is out of range high. (>86.5°).
28	AOC_FAULT_SETS_FAULT_LEVEL_A Bit is set if an AOC system fault caused a no dispatch condition.
29	OTHER_CHANNEL_POWER Bit is set if the local channel determines that the remote channel has lost power. The determination is based on the crosslink and remote channel pressure sensor data.

Maintenance Word No. 3 Octal Label 352
Table 030

**ON A/C 101-200,

BIT	MAINTENANCE WORD DEFINITIONS
14	N1 CROSSCHECK Bit is set if the local and remote N1 signals differ by more the 60 rpm for 1 second.
15	PMA (N2) CROSSCHECK Bit is set if the local and remote N2 signals differ by more than 85 rpm for 1 second.
16	PMA FAULT Bit is set if N2 > 5000 rpm and EEC power is being supplied by the SCU.
18	T2 CROSSCHECK Bit is set if the local and remote (engine) T2 signals differ by more than 3°C for 2 seconds.
19	T5 CROSSCHECK Bit is set if the local and remote EGT signals differ by more than 100°C for 5 seconds.
20	TF CROSSCHECK Bit is set if the local and remote fuel temperature signals differ by more than 10°C for 5 seconds.
21	TOIL CROSSCHECK Bit is set if the local and remote oil temperature signals differ by more than 10°C for 5 seconds.
22	T3 CROSSCHECK Bit is set if the local and remote high pressure compressor exit temperature signals differ by more than 50°C for 5 seconds.
24	FMU CROSSCHECK Bit is set if the fuel flow resolver position between channels differs by more than one degree, or if the channels do not agree on the type of feedback device installed (LVDT or Resolver).
25	REVERSER CROSSCHECK Bit is set if the local and remote reverser position signals differ by more than 5%.
26	TRA CROSSCHECK Bit is set if the local and remote TRA input signals differ by more than 1.5° resolver for one second.
27	PAMB LINE FAULT

BIT	MAINTENANCE WORD DEFINITIONS
	Bit is set if the engine PAMB input is soft failed by ADC data (both ADC altitudes agree, at least one is heated and both disagree with the engine probe).
28	START/TANDEM BLEED FAILED OPEN Bit is set in Channel B if the start bleed is failed open (right hand valve). Bit is set in Channel A if the tandem bleed is failed open. Fault is based on a T29 temperature limit as a function of delta TAMB.
29	CROSSLINK FAILURE Bit is set if the ARINC high speed channel cross-link is failed.

Maintenance Word No. 4 Octal Label No. 353
Table 031

**ON A/C 101-104,

BIT	MAINTENANCE WORD DEFINITIONS
14	OVERSPEED SOL W/A Bit is set if an overspeed solenoid wrap-around failure is detected. Indicates a possible failure of the overspeed solenoid coil or its related wiring.
15	START BLEED SOL W/A Same as bit 14 but applies to the start bleed solenoid.
16	TANDEM BLEED SOL W/A Same as bit 14 but applies to the tandem bleed solenoid.
17	FUEL/OIL COOLER SOL W/A Same as bit 14 but applies to the fuel/oil cooler solenoid.
18	IDG AOHEV SOL W/A Same as bit 14 but applies to the IDG air/oil exchanger valve override solenoid.
19	A/C 28 VOLTS.PERF.SOL.POWER Bit is set if an A/C 28 volts performance solenoid power outage is detected with a duration greater than ten seconds.
20	TRC SOL W/A Same as bit 14 but applies to the rotor heating control solenoid.
22	TCA SOL W/A

BIT	MAINTENANCE WORD DEFINITIONS
	Bit is set if a turbine (blade and vane) cooling air solenoid wrap-around failure is detected.
24	PMA SOL CURRENT SENSED RESET Bit is set if a high side short to ground of one or more of the PMA solenoids has occurred.
25	ENG SOL CURRENT SENSE RESET Same as bit 24 but applies to the engine solenoids.
27	MODE INDICATOR W/A Bit is set if the actual position of the low-side switch does not agree with the commanded position.
29	OVERSPEED FAILED LAST SHUTDOWN Bit is set if an overspeed system fault was detected on the last shutdown. During initialization the FADEC will read whether this fault occured during the current ground leg and if so will flag a level A condition. The bit and the level A condition can only be cleared by starting the engine, shutting down and passing the overspeed spooldown test. The manner in which this bit was implemented is based on the ground leg counter, thus the fault will be hidden if the ground leg counter is incremented (cycling of fuel cutoff with EEC powered), without having started the engine.

Maintenance Word No. 5 Octal Label No. 354
Table 032

**ON A/C 105-200,

BIT	MAINTENANCE WORD DEFINITIONS
14	OVERSPEED SOL W/A Bit is set if an overspeed solenoid wrap-around failure is detected. Indicates a possible failure of the overspeed solenoid coil or its related wiring.
15	START BLEED SOL W/A Same as bit 14 but applies to the start bleed solenoid.
16	TANDEM BLEED SOL W/A Same as bit 14 but applies to the tandem bleed solenoid.
17	FUEL/OIL COOLER SOL W/A Same as bit 14 but applies to the fuel/oil cooler solenoid.
18	IDG AOHEV SOL W/A Same as bit 14 but applies to the IDG air/oil exchanger valve override solenoid.
19	A/C 28 VOLTS.PERF.SOL.POWER Bit is set if an A/C 28 volts performance solenoid power outage is detected with a duration greater than ten seconds. Below 1800 rpm N2, the bit is allowed to self-heal (clear) if A/C 28 volt power is present for a duration greater than ten seconds. Between 1800 rpm and 5800 rpm N2, the bit is inhibited from setting. Above 5800 rpm N2, the bit will latch once set and is not allowed to self-heal.
20	TRC SOL W/A Same as bit 14 but applies to the rotor heating control solenoid.
22	TCA SOL W/A Bit is set if a turbine (blade and vane) cooling air solenoid wrap-around failure is detected.
24	PMA SOL CURRENT SENSED RESET Bit is set if a high side short to ground of one or more of the PMA solenoids has occurred.
25	ENG SOL CURRENT SENSE RESET Same as bit 24 but applies to the engine solenoids.
27	MODE INDICATOR W/A Bit is set if the actual position of the low-side switch does not agree

BIT	MAINTENANCE WORD DEFINITIONS
	with the commanded position.
29	OVERSPEED FAILED LAST SHUTDOWN Bit is set if an overspeed system fault was detected, and successful overspeed system spooldown test has not subsequently occurred. Previous flight or ground legs must be reviewed to determine the cause of the overspeed system failure. During initialization, (via fuel cutoff or power on), the EEC will determine if there was a previously recorded overspeed system fault. If true, this bit is set. The bit can be cleared by starting the engine, shutting down, and passing the overspeed test. This bit may be set along with either a fault level A or a fault level B condition. If set along with fault level A or fault level B, this bit will not be cleared until the overspeed spooldown test is successfully run.

Maintenance Word No. 5 Octal Label No. 354
Table 032

**ON A/C 101-200,

The EEC outputs data with the following status matrices :
Sign/Status Matrix (Bits 31, 30)

Bit No. 31	Bit No. 30	Designated BNR Data	Designated Discrete Data	Designated BCD Data
0	0	Failure Warning	Normal Operation	Normal Operation
0	1	No Computed Data	(Not Used)	No Computed Data
1	0	Functional Test	(Not Used)	(Not Used)
1	1	Normal Operation	(Not Used)	(Not Used)

Status Matrix Definition
Table 033

In the absence of a failure (or unless specified otherwise in this document) each parameter, status and maintenance word is sent with the sign/status matrix (SSM) set to "Normal Operation". This is true for all configurations of the EEC system. In the maintenance data retrieving mode only the maintenance words and the delta flight leg word are transmitted. In the presence of a failure, the following information explains the selected SSM.
The SSM for the data parameters is coded using one of following logical methods. Which method is used for each individual data parameter is noted in the data description on Table 3.
Type :

1) Normal — If local or crosstalked data selected
   NCD — If synthesized or faisafe data selected
   FW — If data is past value or faisafe
2) FW — If the engine sensor is latch failed
3) Not used
4) Applies to EPR Actual (EPRI)
   FW — If P5 is past value or synthesis OR engine sensed P2 is invalid OR the P2 heater is off and T2 < 7.2°C.
   DEM function is invalid following IC or selected altitude is synthesized from an unvalidated ADC source.
5) Normal — For all conditions
6) Applies to Ratio Units
   NCD — If either parameter is synthesized but neither parameter is past value.
   FW — If past value of fuel flow or burner pressure is selected.
7) Applies to EPR Command (EPRREF) and max available EPR (EPRTO)
   FW — If in alternate mode after manual selection
   OR
   If channel in control and is in alternate mode
   OR
   If channel not in control and other channel in alternate mode

OR

If channel not in control and crosstalk from other channel not available

NOTE : although N1 power setting is used in reverse operation, the FW is not set unless a failure of the EPR mode has occurred.

8) Applies to the rating word (octal label 050)
NCD If DEM input is invalid

9) Applies to Delta Flight Leg
FW When ground leg data is transmitted

During the static ground test, the following parametric data values will be transmitted over the serial digital data buses in the absence of system failures :

PARAMETER	OCTAL LABEL	STATIC ENGINE VALUE CONTROL OUTPUT
- Low Rotor Speed, N1	346	Approximately 0
- High Rotor Speed, N2	344	Approximately 0
- Exhaust Gas Temp., EGT	345	Current Engine Temperature
- EPR Actual	340	Approximately 1
- Burner Pressure, P B	264	Ambient Pressure
- EPR Command	341	EPR Command Depends on Throttle position
- Max Available EPR Rating	342	Rating Depends on Static Conditions
- Thrust Lever Angle	133	Actual Trottle Resolver Setting
- SVA Feedback	325	Full Open*
- 2.5 Bleed Feedback	335	Full Open
- Inlet Total Pressure, P2	131	Ambient Pressure
- Inlet Total Temperature, T2	130	Ambient Temperature
- Fuel Temperature	115	Current Fuel Temperature
- Oil Temperature	316	Current Oil Temperature
- Ambient Pressure, Pamb	114	Ambient Pressure
- Exhaust Gas Pressure, P5	132	Ambient Pressure
- Turbine Case Cooling Feedback	331	Full Closed
- Air/Oil Cooler Valve Feedback	332	Full Open
- Fuel Flow Request	334	Indeterminate**
- Compressor Exit Temperature	265	Current Engine Temperature
- Reverser Position	137	Stowed
- Corrected N2 Speed	336	Approximately 0
- CJC Temperature	320	Approximately Ambient Temperature

* SVA actuator may drift from full open after engine shutdown.

** When shutdown and neither channel is in control the command will display the actual metering valve position. This position may be any value do to pressure loading.

NOTE : All outputs, in absence of failure, will represent the local channel data with the exception of the reverser and TRA positions which will represent the local channel data, when in ground test configuration, whether or not a fault has occured.

Serial Digital Bus Parametric
Data During Ground Test
Table 034

**ON A/C 101-104,

DISCRETE WORD	OCTAL LABEL	BIT POSITION 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
EEC Status Word No. 1	270	1	0	0	0	a	b	c	*	1	1	1	1	a,d	g	0,d	0,d
EEC Status Word No. 2	271	0	0	X	X	*	0	0	X	X	X	X	X	X	X	X	X
EEC Status Word No. 3	272	0	*	0	0	*	*	0	0	0	0	0	0	0	0	*	1h
EEC Status Word No. 4	273	0	0	0	*	*	*	*	0	0	X	*	0	*	0	0	1
EEC Status Word No. 5	274	X,d	X,d	X,d	*	*	0	0	X	X	0	0	0	X	*	*	*
EEC Status Word No. 6	050	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e
EEC Status Word No. 7	146	e	e	e	e	e	e	*	f	f	f	f	*	*	*	*	1
EEC Maint. Word No. 1	350	0	0	0	0	0	0i	0	0	0	0	0	*	0	0	0	0
EEC Maint. Word No. 2	351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEC Maint. Word No. 3	352	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0
EEC Maint. Word No. 4	353	0	0	0	*	0	0	0	0	0	*	0	0	0	0	0	0
EEC Maint. Word No. 5	354	0	0	0	0	0	0	0	*	0	*	0	0	*	0	*	0

X = Variable condition, either state may be valid.
* = Spare, always cleared

a = 0 if not switched to N1 mode
    1 if switched to N1 mode
b = Normally 0 unless reversers manually deployed
c = One channel 0, other is 1
d = Always represents the local channel input during ground test

e = Configuration dependent
f = EPR class dependent
g = 1 if channel A
  = 0 if channel B
h = Will be zero unless an SCU is installed, in which case the bit will be normally equal to one.
i = Following the ground actuator test, will be set if test passed.

Serial Digital Data Bus Discrete
Data During Ground Test
Table 035

**ON A/C 105-200,

DISCRETE WORD	OCTAL LABEL	BIT POSITION 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
EEC Status Word No. 1	270	1	0	0	0	a	b	c	*	1	1	1	1	a,d	g	0,d	0,d
EEC Status Word No. 2	271	0	0	X	X	*	0	0	X	X	X	X	X	X	X	X	X
EEC Status Word No. 3	272	0	*	0	0	*	*	0	0	0	0	0	0	0	0	*	1h
EEC Status Word No. 4	273	0	0	0	*	*	*	0	0	0	X	*	0	*	0	0	1
EEC Status Word No. 5	274	X,d	X,d	X,d	*	*	0	0	X	X	0	0	0	X	*	*	*
EEC Status Word No. 6	050	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e
EEC Status Word No. 7	146	e	e	e	e	e	e	*	f	f	f	f	*	*	*	*	1
EEC Maint. Word No. 1	350	0	0	0	0	0	0i	0	0	0	0	0	0	*	0	0	0
EEC Maint. Word No. 2	351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEC Maint. Word No. 3	352	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0
EEC Maint. Word No. 4	353	0	0	0	*	0	0	0	0	0	*	0	0	0	0	0	0
EEC Maint. Word No. 5	354	0	0	0	0	0	0	0	*	0	*	0	0	*	0	*	0

X = Variable condition, either state may be valid.
* = Spare, always cleared

a = 0 if not switched to N1 mode
    1 if switched to N1 mode

b = Normally 0 unless reversers manually deployed
c = One channel 0, other is 1
d = Always represents the local channel input during ground test
e = Configuration dependent
f = EPR class dependent
g = 1 if channel A
  = 0 if channel B
h = Will be zero unless an SCU is installed, in which case the bit will be normally equal to one.
i = Following the ground actuator test, will be set if test passed.

Serial Digital Data Bus Discrete
Data During Ground Test
Table 035

**ON A/C 101-200,

3. System Installation Particular Precautions

A. Introduction
The FADEC system consists of components and cabling mounted within the nacelle and interfaces with components located in the airframe.
Both because of its critical nature and authority and of its digital technology, the FADEC system requires precautions during system installation against :
- common points between engines
- lightning strike and EMI (Electro Magnetic Interference) induced perturbations.

B. Nacelle Installation
(1)General
Special features are used in system components design and integration inside the nacelle to protect the FADEC system against lightning strikes and electromagnetic induced transients. These features are :
- integral shielded housing on FADEC,
- equipment bonding,
- individual shielding on all the wiring, grounded to component housings,
- shields terminated at connector backshells,
- system isolation from engine case ground : the FADEC provides a single point ground reference for the system,
- protective devices on circuit boards,
- software design based on sampling and error detection techniques.

**ON A/C 106-200,

R Post SB 73-2029 For A/C 106-200,

(2)Electrical harness (Ref. Fig. 070, 071)
There are six engine supplied electrical harnesses used to interconnect the engine control system components and supply airframe data and power to various control system components.
The engine supplied electrical harnesses are of open bundle construction designed for full repairability. Single-shielded conductors are employed for EMC and lightning protection. Shielding is constructed of nickel plated copper braiding and grounded at both ends via enclosed backshells. Connector backshells provide strain relief and anti-rotation and are capable of being retracted over the cable to permit servicing of connectors.

**ON A/C 101-200,

(2)Electrical harness (Ref. Fig. 070, 072)
There are six engine supplied electrical harnesses used to interconnect the engine control system components and supply airframe data and power

to various control system components.
The engine supplied electrical harnesses are of open bundle construction designed for full repairability. Single-shielded conductors are employed for EMC and lightning protection. Shielding is constructed of nickel plated copper braiding and grounded at both ends via enclosed backshells. Connector backshells provide strain relief and anti-rotation and are capable of being retracted over the cable to permit servicing of connectors.

**ON A/C 101-105,

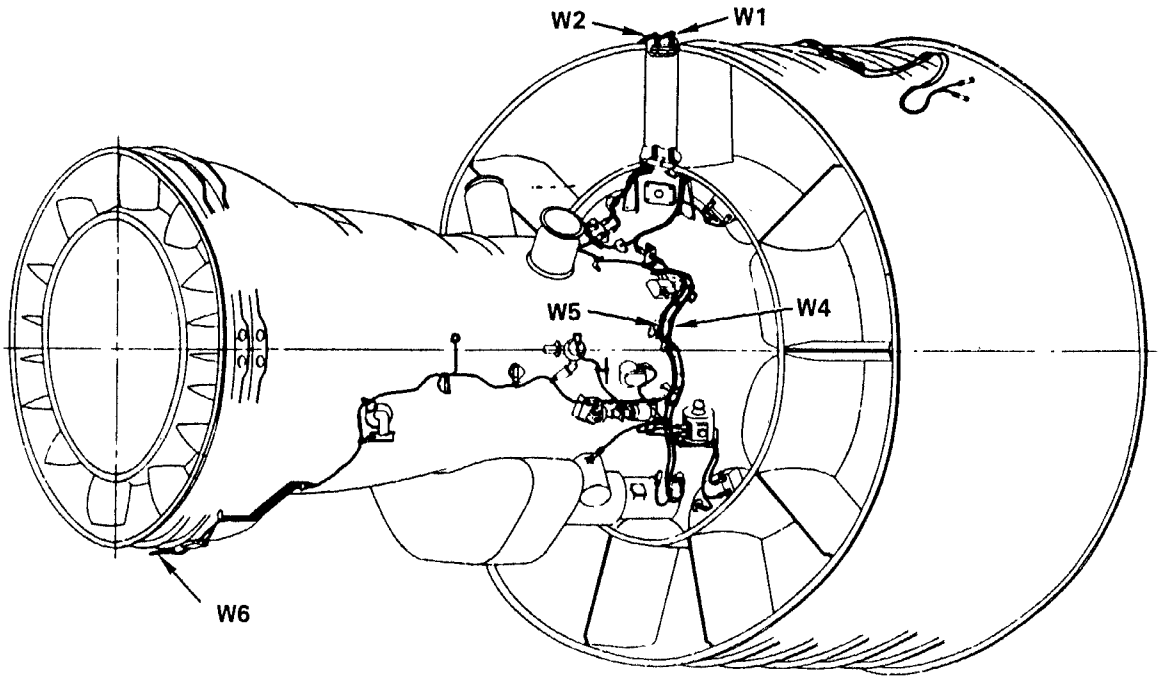
Post SB 71-2024 For A/C 101-105,

Post SB 73-2029 For A/C 101-105,

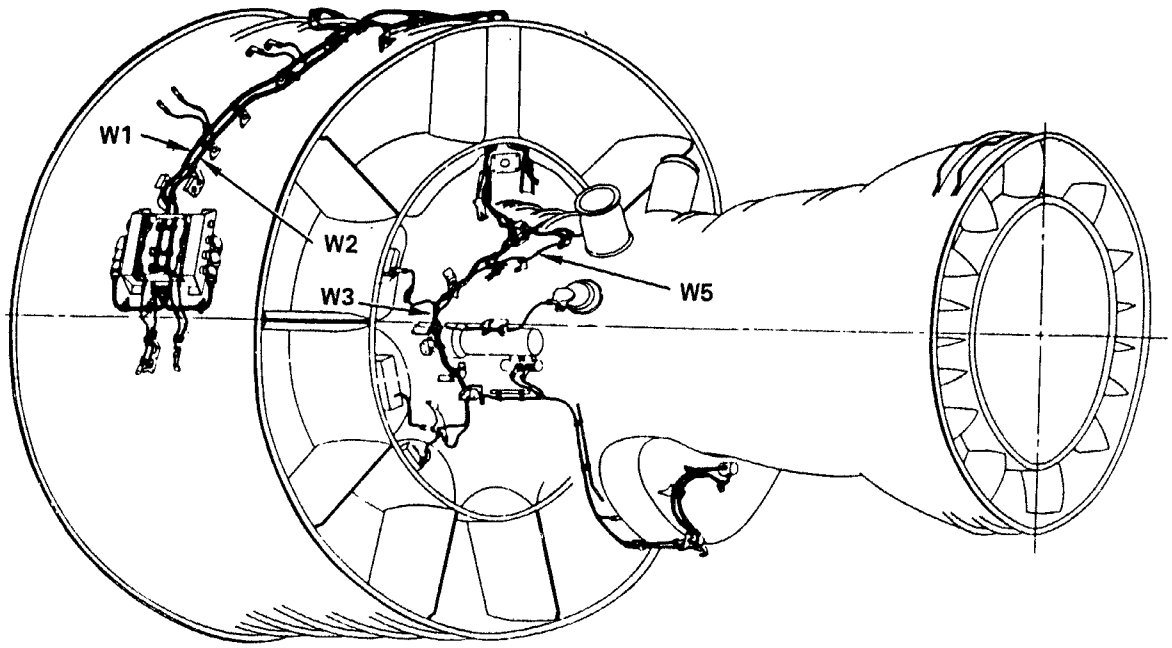
(2)Electrical harness (Ref. Fig. 070, 073)
There are six engine supplied electrical harnesses used to interconnect the engine control system components and supply airframe data and power to various control system components.
The engine supplied electrical harnesses are of open bundle construction designed for full repairability. Single-shielded conductors are employed for EMC and lightning protection. Shielding is constructed of nickel plated copper braiding and grounded at both ends via enclosed backshells. Connector backshells provide strain relief and anti-rotation and are capable of being retracted over the cable to permit servicing of connectors.

**ON A/C 101-200,

RIGHT SIDE ENGINE

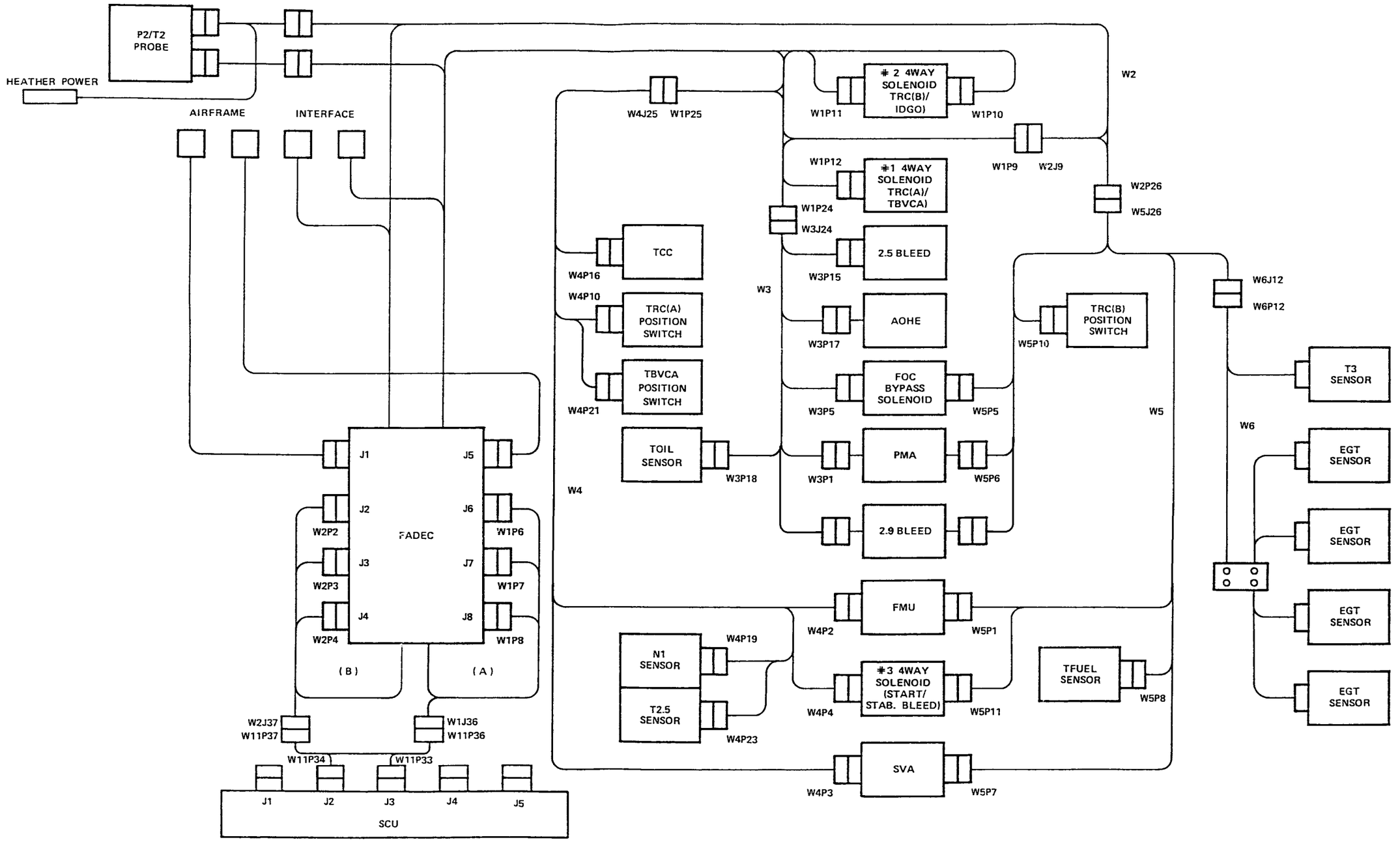


LEFT SIDE ENGINE



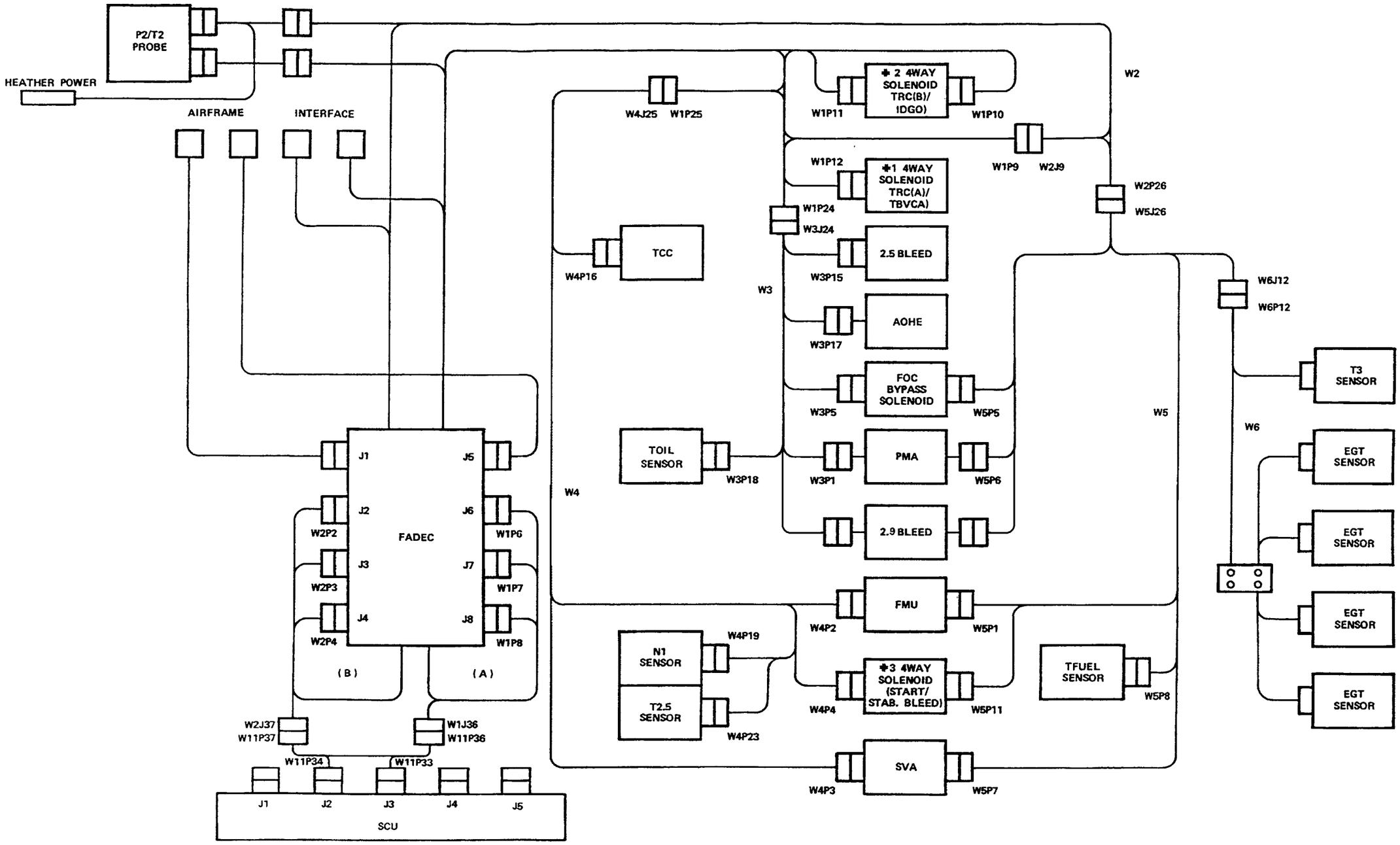
BM5 73 25 00 0 KMMO - 24 - 19
DM5

Electrical Harness
Figure 070



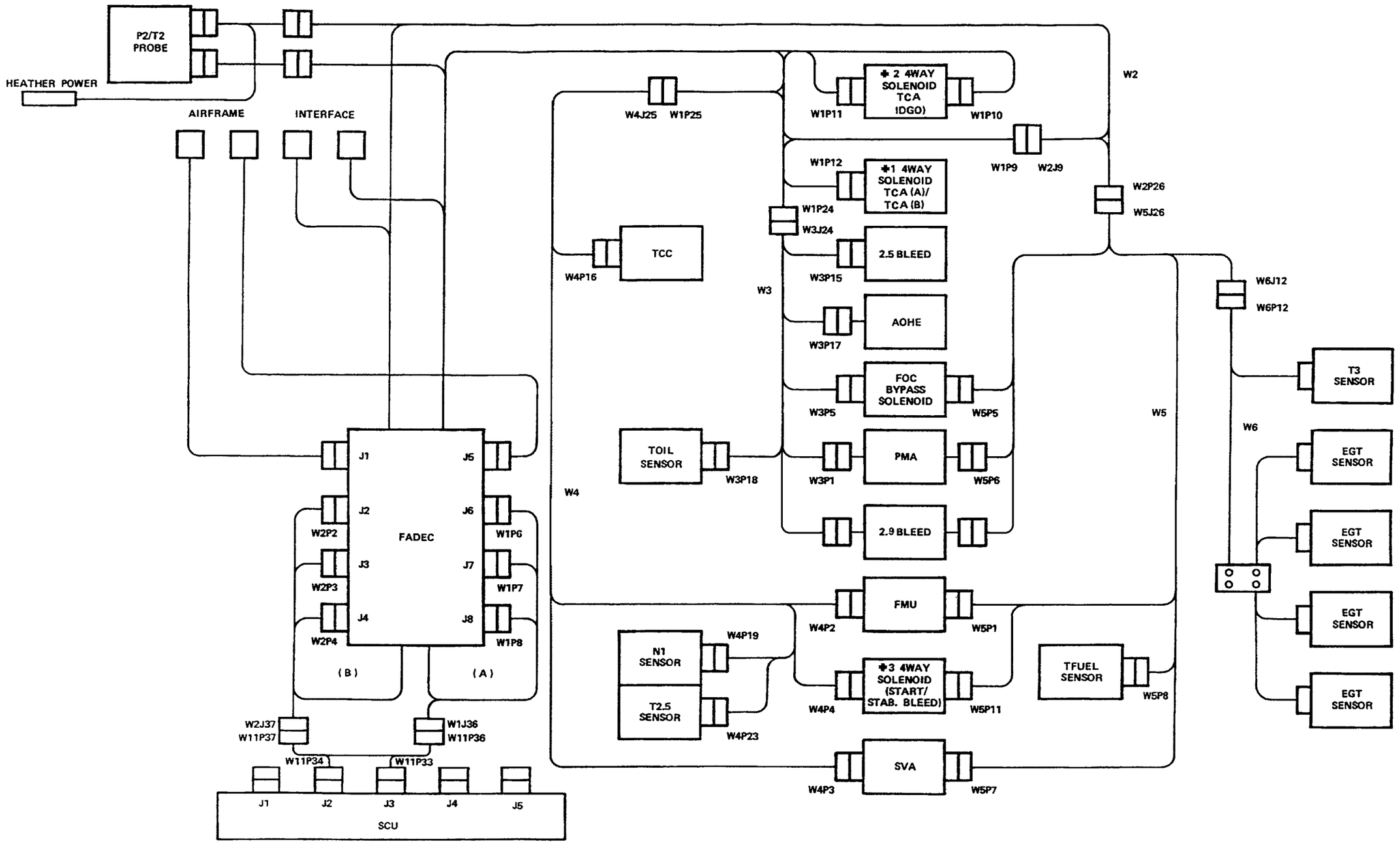
BM5 73 25 00 0 KQE0 00

Engine Control System Electrical Harness
Figure 071



Engine Control System Electrical Harness
Figure 072

BM5 73 25 00 0 KQA0 00



BM5 73 25 00 0 KQL0 00

Engine Control System Electrical Harness
Figure 073

C. Aircraft Installation

(1)Engine isolation (Ref. Fig. 074)

The two FADEC systems are isolated from each other by using the following design concepts :

- segregated independent harnesses
- independent controls, except for the FADEC ground test which is inhibited as soon as one engine is running or in flight
- different input/output ports on components from/to FADEC system harnesses
- incorporation of protective devices in serial in the wiring to avoid propagation of a lightning strike induced current from the FADEC system to aircraft equipment or the contrary.

In addition, the two systems have a total functional independence.

(2)Isolation between FADEC channels (Ref. Fig. 074)

Integration on aircraft is defined to minimize as often as possible common points between the two FADEC channels. The FADEC system harnesses interfacing with the airframe are segregated on three independent looms, using different electrical routes in the aircraft.

Route SA	Route SB	Route M
sensitive wires interfacing with CHA	sensitive wires interfacing with CHB	non-sensitive wires, common to both CH
wiring to FADEC system	Wiring to FADEC system	wiring to FADEC system
- throttle control lever position CHA (*) - ADC1 (*) - TCC (*) - Input Discretes(***): . Probe heat . Fire Maintenance . Mode Select . Reset	- throttle control lever position CHB (*) - ADC2 (*) - Input Discretes(***): . Fire . Mode Select . Reset	- Perf. sol power supply (**) - Ground test power supply (SCU) (**)
wiring to airframe	wiring to airframe	
- N2 (*) - Output bus CHA (*) - Mini mux output bus(*) - Output discrete : N1 mode engaged (***)	- N1 (*) - Output bus CHB (*) - Output discrete : N1 mode engaged (***)	

(*) individual shielding from Nacelle/Pylon interface to the avionics compartment

(**) individual shielding from Pylon/Wing interface to the avionics compartment

(***) individual shielding in the wing

(3)Lightning strike and EMI protection :

For lightning strike and EMI protection purposes, special features are used in the aircraft installation :
- wiring protection
- equipment protection

(a)Wiring protection (Ref. Fig. 075, 076)

In addition to the attenuation provided by the aircraft structure, each of the three looms is protected, with braided shielded conduits, or light alloy tubes, (bonded at each extremity by redundant means) from the nacelle interface to the wing root.

All the bundles are composed of pairs or triplets twisted. Each individual cable shielding is bonded at each extremity and at intermediate connections.

1 Nacelle interface : The interface used with the nacelle is located on the left fan disconnect panel and is constituted by a closed metallic junction box interfacing with the four nacelle connectors and the three aircraft looms.

2 Pylon : In the pylon the looms are routed through braided shielded conduits from the fan disconnect panel to the wing interface.

3 Wing leading edge : In the wing leading edge the two looms are individually routed through light allow tubes and in krueger zone through braided shielded conduits.

4 Wing trailing edge : In the wing trailing edge the loom is routed from the interface with the pylon to the shroud box in light alloy tube and from the shroud box to the fuselage through a braided shielded conduit.

The protection is performed by a metallic box.

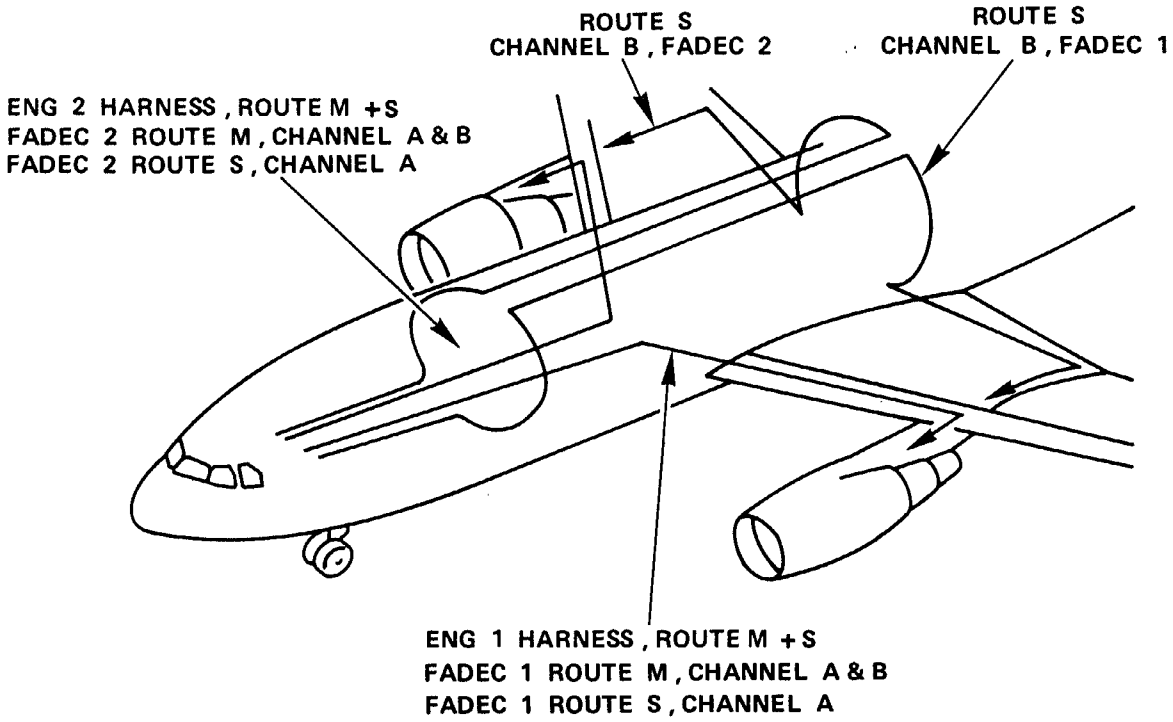
(b)Equipment protection (Ref. Fig. 077)

The airframe equipment are protected against lightning induced transients either by internal protection or protective devices added in serial in the airframe wiring to increase the present level of protection of the concerned interfaces.

One independent surge suppressor unit for each FADEC is installed on FR20 in the fuselage at the entry of avionics compartment.

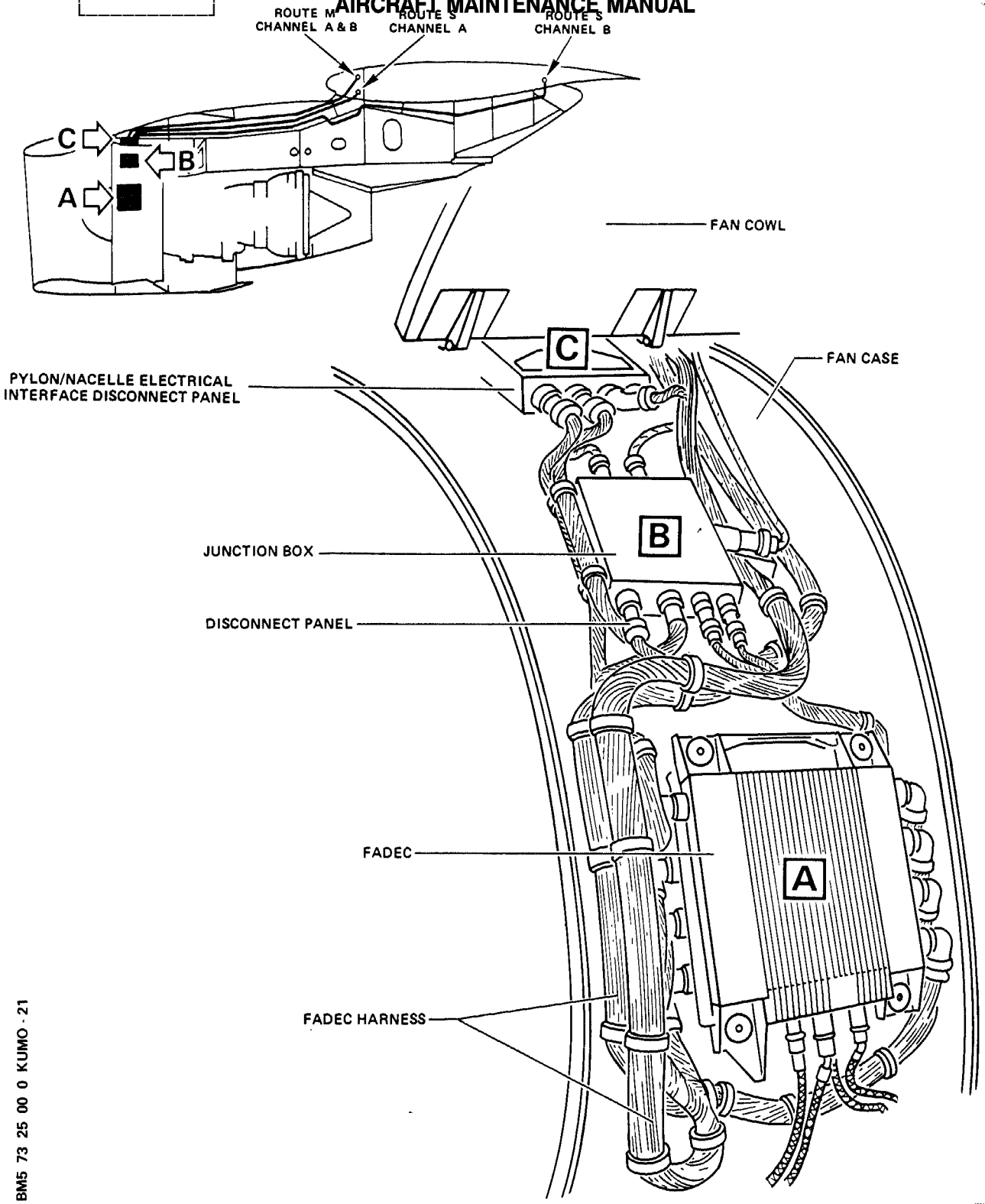
These surge suppressor units are used to increase the level of protection of the following FADEC/Airframe interfaces :
- ARINC interface (output busses, TCC, ADC1, ADC2)
- Discrete interface
- Power supply interface.

(Ref. Fig. 076)

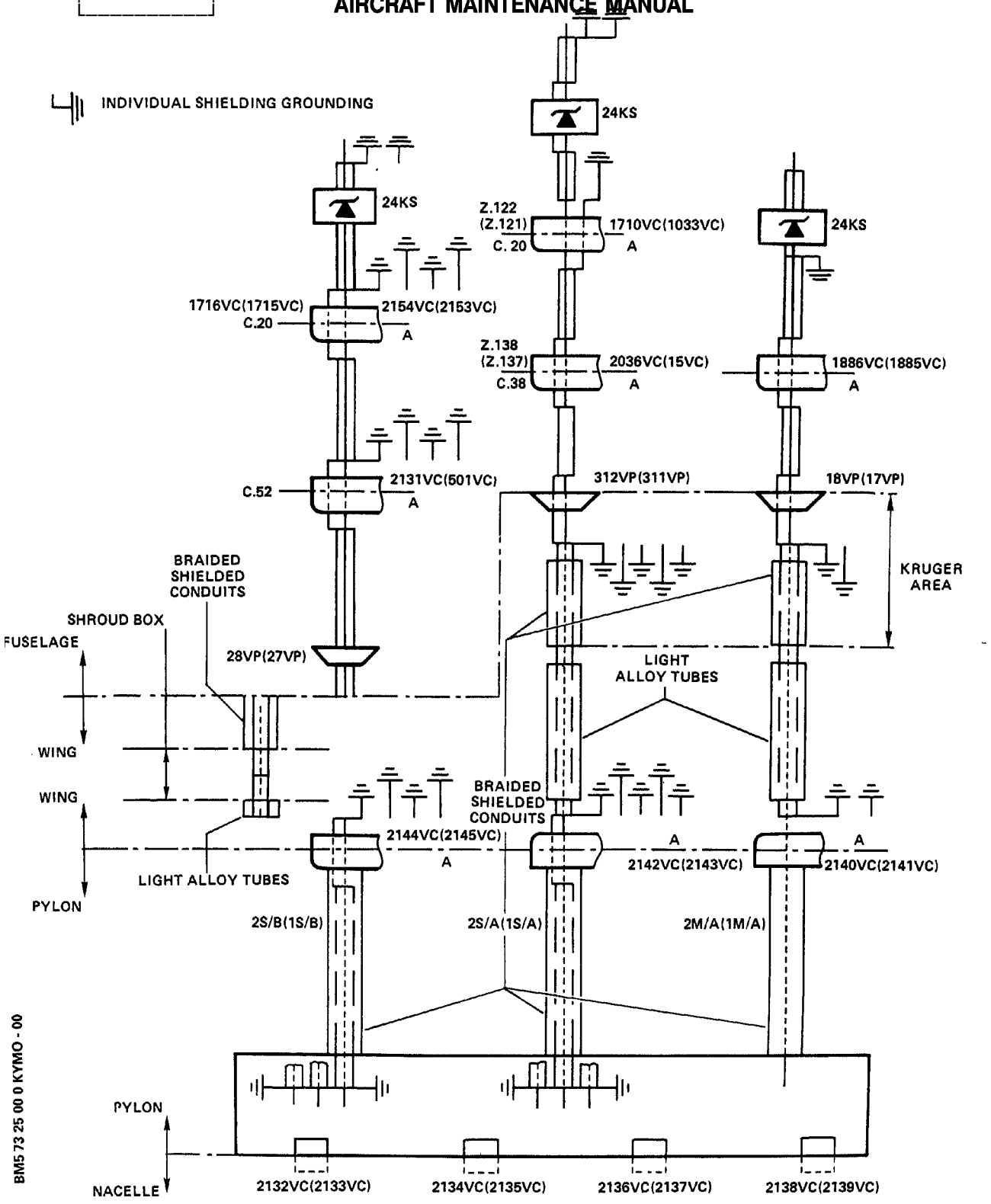

ROUTE S
CHANNEL B , FADEC 2
ROUTE S
CHANNEL B , FADEC 1
ENG 2 HARNESS , ROUTE M +S
FADEC 2 ROUTE M , CHANNEL A & B
FADEC 2 ROUTE S , CHANNEL A
ENG 1 HARNESS , ROUTE M +S
FADEC 1 ROUTE M , CHANNEL A & B
FADEC 1 ROUTE S , CHANNEL A

BM5 73 25 00 0 KSMO - 20

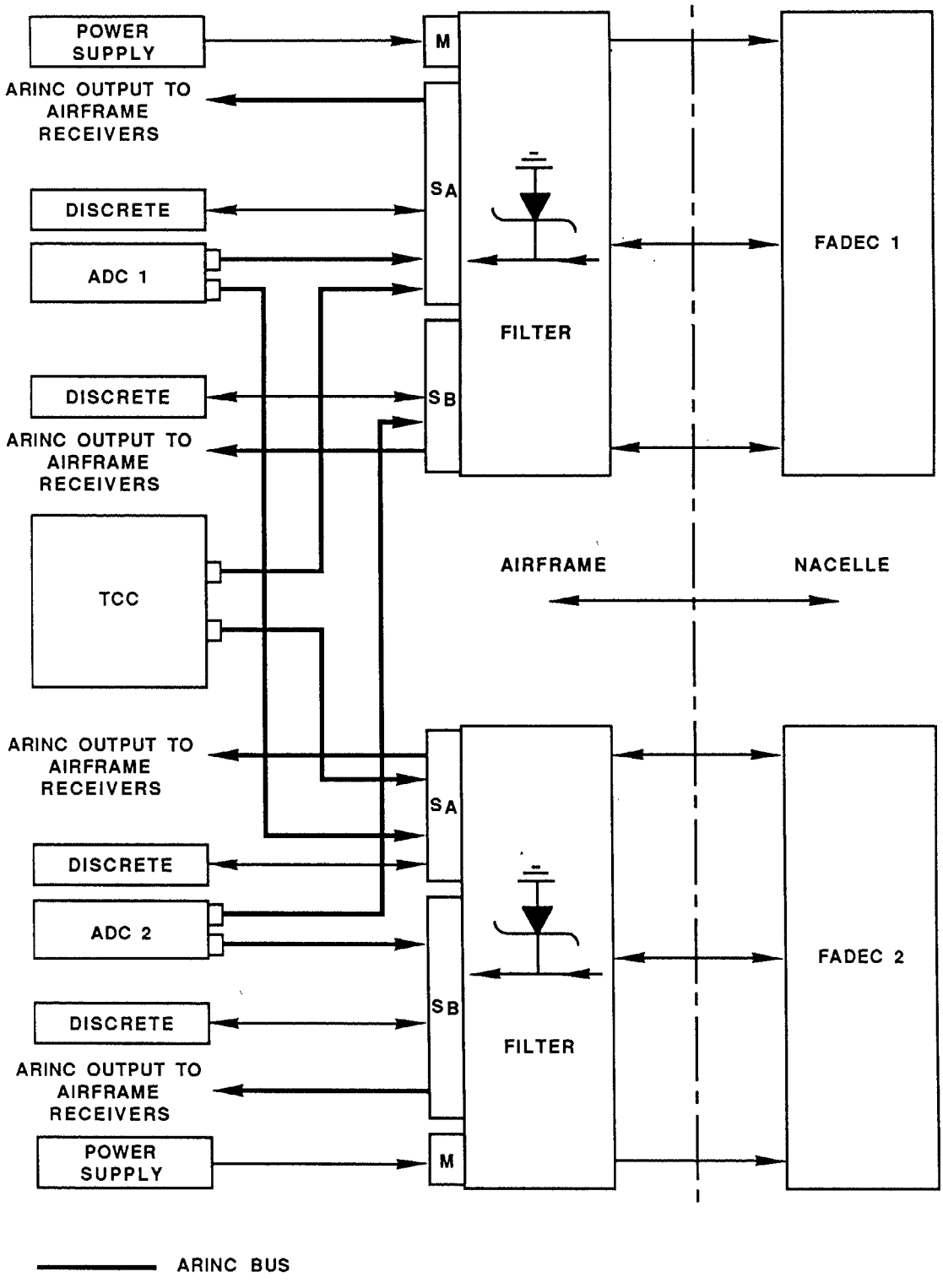
Aircraft Installation
Figure 074



Pylon Installation
Figure 075



Lightning Protection Installation Principle Engine 1 (2)
Figure 076



BM5 73 25 00 0 KYSO - 20

Additional Equipment Protection
Figure 077

1. Fuel System

A. General

(Ref. Fig. 001)

(1)Fuel flow indicating

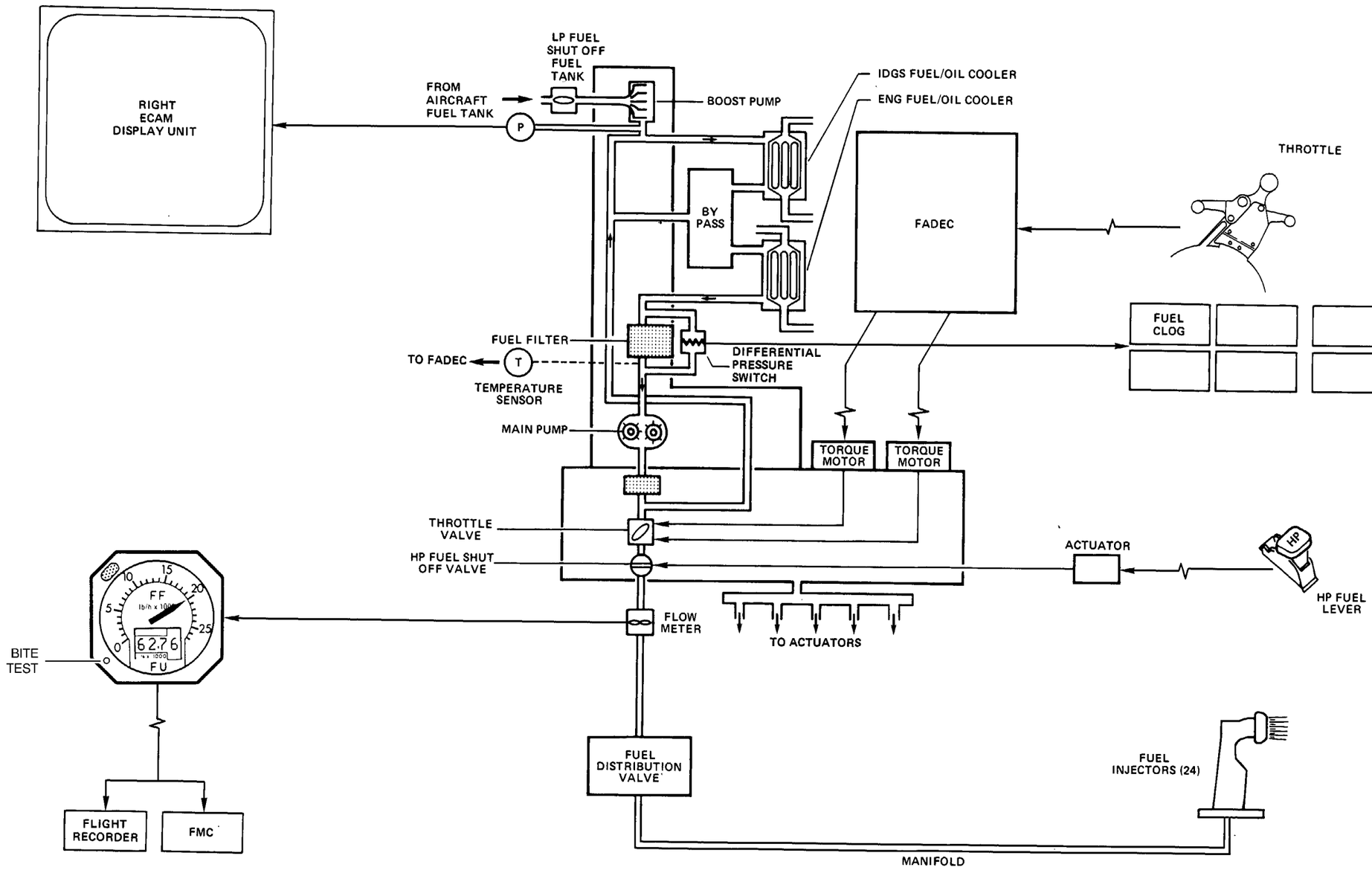
The fuel flow indicating comprises :

- A mass-flow rate measuring transmitter, mounted above the fuel metering unit, located at 3 o'clock on the HP compressor case and reading fuel flow at the inlet of the fuel distribution valve.
  The transmitter generates a signal independent of any power source.
  This signal is sent to the microprocessor housed in the body of the fuel flow rate/fuel used indicator.
- Fuel Flow Rate/Fuel Used Indicator
  The FF/FU indicator located on panel 4VU in the flight compartment, displaying instantaneous fuel flow rate in analog form and fuel used in digital form.
  Other outputs from the indicator unit are fed to the FMC and to the DFDAU.

(2)Indications and warnings

- Fuel Pressure
  The fuel pressure is measured at the pump interstage.
  The fuel pressure transmitter transmits a continuous signal proportional to fuel pressure to the right ECAM display unit.
- Fuel Filter Clogging
  A differential pressure switch across the inlet and outlet of the fuel filter monitors for clogging of the filter element. In this event, it operates the associated FUEL FILTER CLOG warning light located on panel 4VU in the flight compartment and a message appears on the left ECAM display unit.

INTENTIONALLY BLANK



BM5 73 30 00 0 KAM0 01

R

Fuel System Indicating
Figure 001

FUEL FLOW INDICATING - DESCRIPTION AND OPERATION

1. General

A. Fuel Flow Transmitter (Ref. Fig. 001)

The fuel flow transmitter is mounted above the fuel metering unit at 3 o'clock on the HP compressor case.

(1)Principle

(Ref. Fig. 002)

- Fuel entering the transmitter first passes axially between radial straightening vanes to remove swirl and other disturbances. The fuel then passes through the rotating measurement assembly, which consists of a multi-vane impeller connected coaxially to a surrounding drum by a spiral spring. The drum entirely shrouds the circumference of the impeller, eliminating viscous drag on the impeller. The drum is rotated at a constant speed of 100 rpm by a low-speed synchronous motor. The motor housing is supported in the center of the transmitter by webs, machined integrally with the transmitter body. The housing supports the motor stator. The stator generates a rotating magnetic field that is followed by a permanent magnet rotor. The rotor is fastened to the drum. The measurement assembly is supported by two bearings that are lubricated by the fuel.

(Ref. Fig. 002)

- The fuel passing through the annular space in the measurement assembly deflects the impeller relative to the drum because of the torque required to impart angular momentum to the fuel. Since the spiral spring has a linear torque/deflection characteristic, the deflection angle is a measure of this torque and, therefore, a measure of the mass fuel flow. This assumes a constant angular velocity, which is the case in this system, since the motor is synchronous and its excitation is crystal controlled. The greater the mass flow rate, the larger the deflection of the impeller relative to the drum. The deflection is measured by four small powerful magnets (two attached 180 degrees apart on both the drum and impeller circumferences) and two pick-off coils on the outside of the nonmagnetic transmitter body (one located over the path of the drum magnets and one over the path of the impeller magnets). As each magnet rotates by its respective pick-off coil, an electrical pulse is induced in the coil. The time lag of the impeller pulses relative to the drum pulses reflects the amount of torque on the impeller and is directly proportional to mass flow rate.

B. Fuel Flow and Fuel Used Indicator

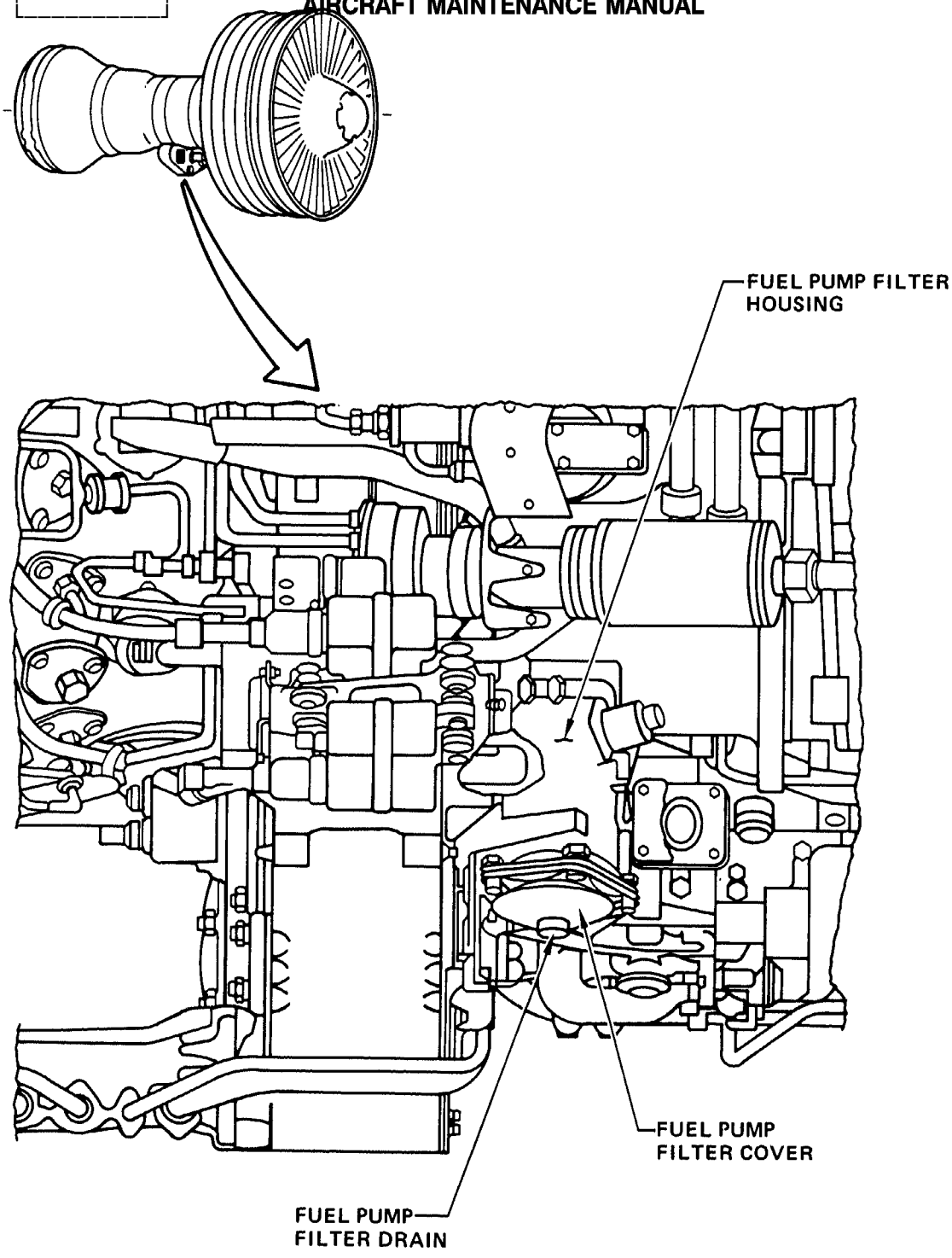
(Ref. Fig. 003)

The combined indicator unit is located on panel 4VU.

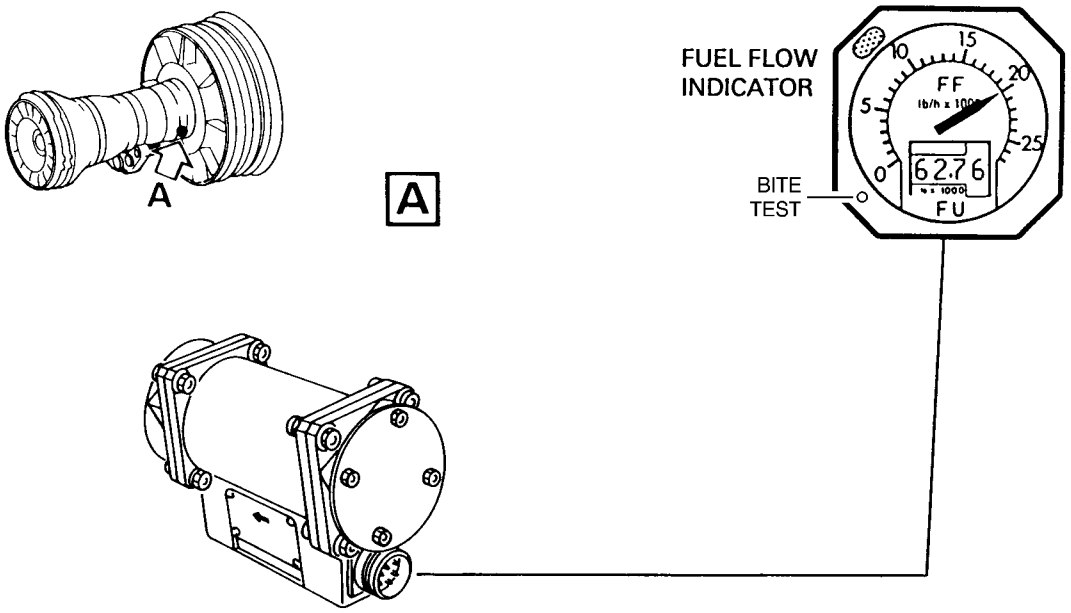
It comprises :

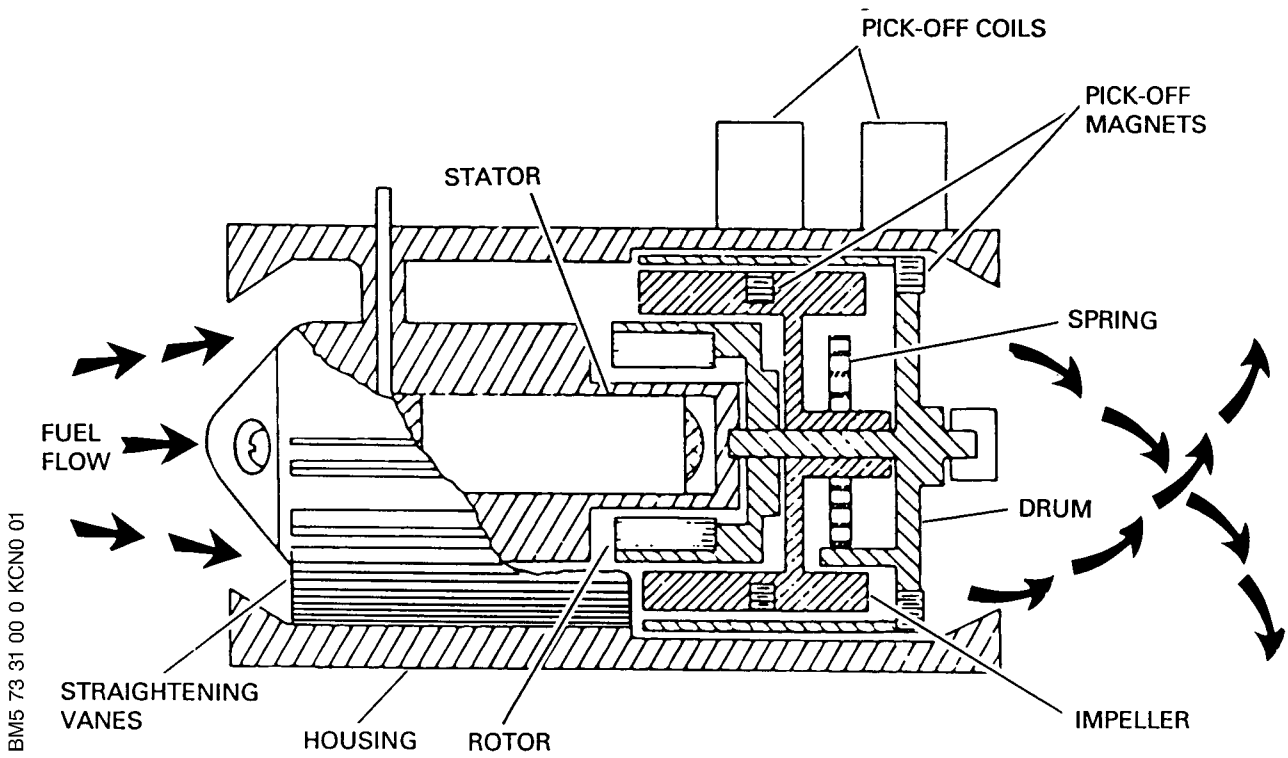
- a microprocessor to calculate fuel flow rate and fuel used from the transmitters pulse signals.
- an analog Fuel Flow rate indicator in Kg/Hour (rang = 0 to 12,500 Kg/H).
- a digital Fuel Used indicator in Kg.

Outputs from the microprocessor (in units of lbs/hour fuel flow) go to the



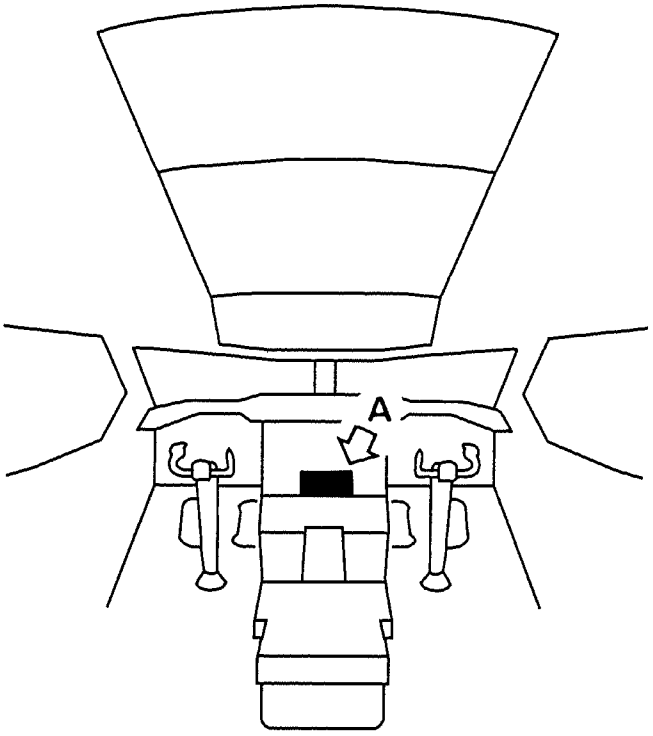
Fuel Pump Filter
Figure 001

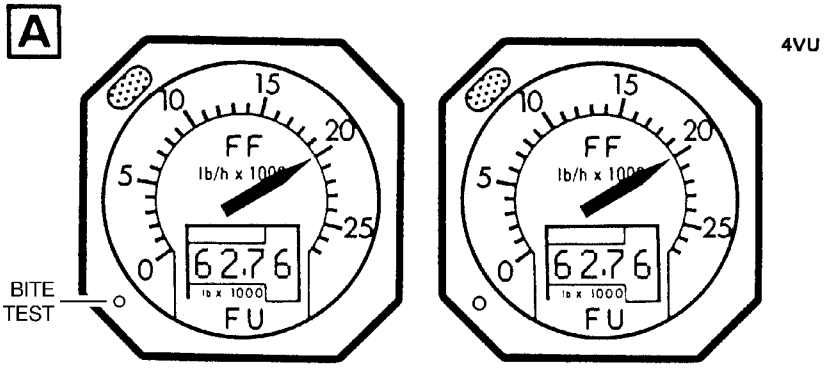




Fuel Flow Transmitter
Figure 002

R





BM5 73 31 00 0 KEM0 01

R

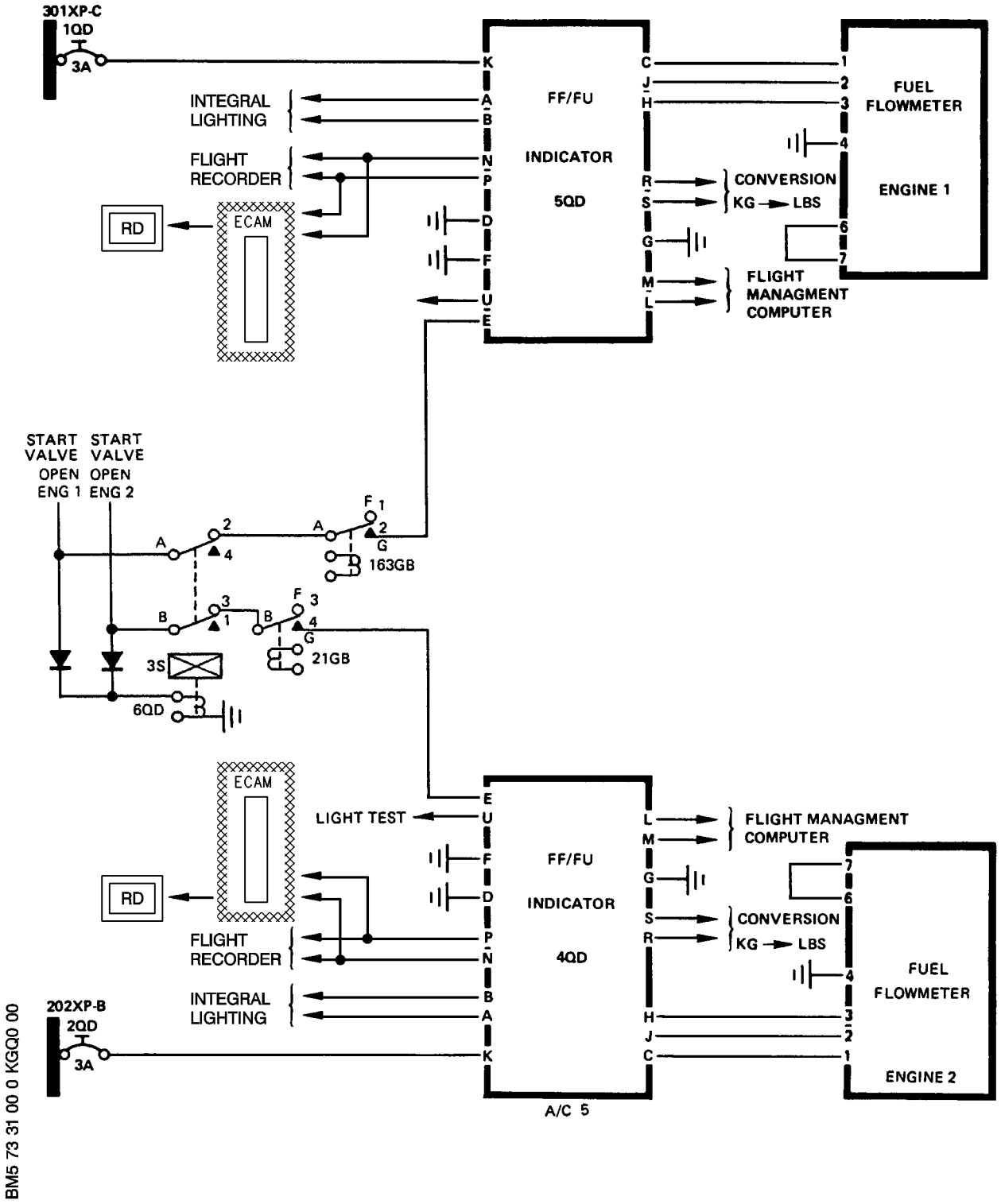
Fuel Flow/Fuel Used Indicator
Figure 003

Flight Management Computer (FMC) and DFDAU.
A BITE test screw is located on the lower left corner of the instrument face. When the indicator is functioning normally and BITE is selected by turning and maintaining the BITE screw, the numeric display will sequentially indicate ROM, µP, 0 (zero) and then continue to integrate the "Blue Dot" value of FF and display the totalised value for as long as the BITE screw is selected. The FF pointer goes to the "Blue Dot" mark on the dial. Upon release of the BITE screw the indicator returns to normal operation after the BITE test sequence has been completed.
Integral lighting of the instrument is provided.

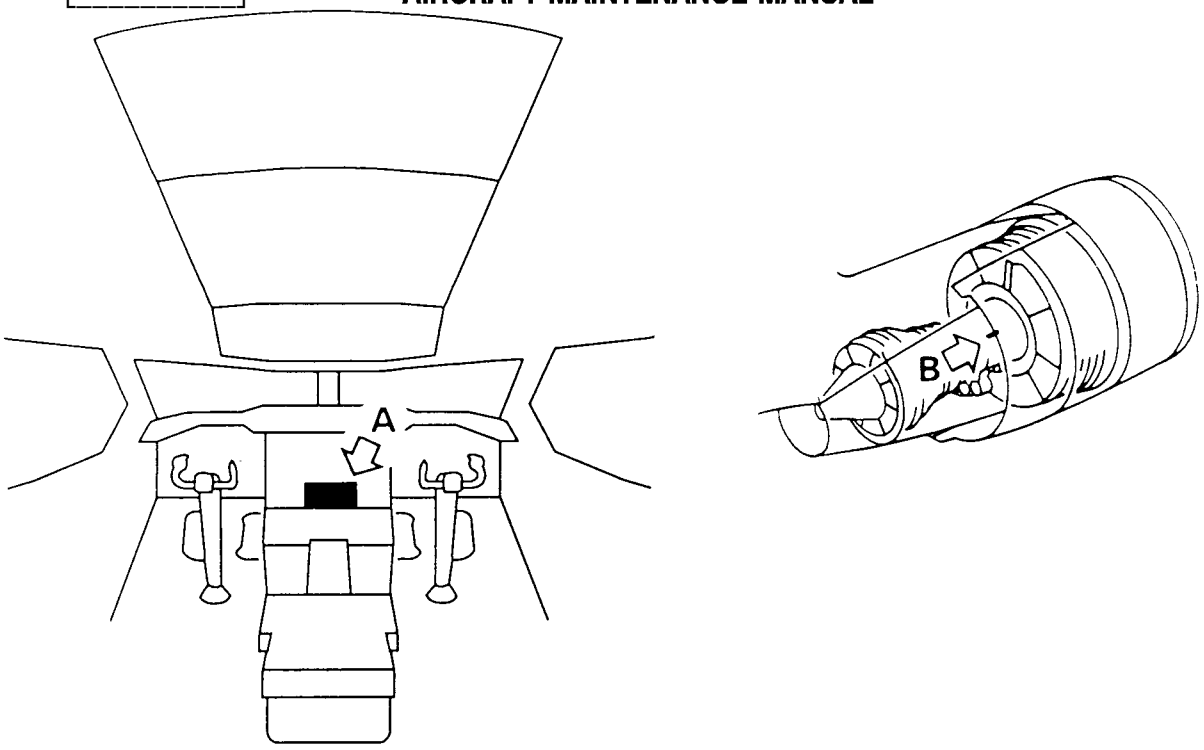
C. Electrical Circuit (Ref. Fig. 004)
It sends pulse signals to a microprocessor housed in the indicator unit, the fuel mass flow being directly proportional to the time between one "start" and "stop" pulse.
The indicator unit is supplied with 115VAC from busbar 20XP-B (202XP-C) via
R circuit breakers 2QD (1QD).
A microprocessor in the indicator unit calculates :
- Fuel flow rate, which is then displayed in analog form.
- Fuel used, displayed in digital form.
- Two digital signals of fuel flow, in units of lbs/h, are also produced by the microprocessor in the indicator unit. These signals are fed to the Flight Management Computer (FMC) and the DFDAU.

2. Component Location
(Ref. Fig. 005)

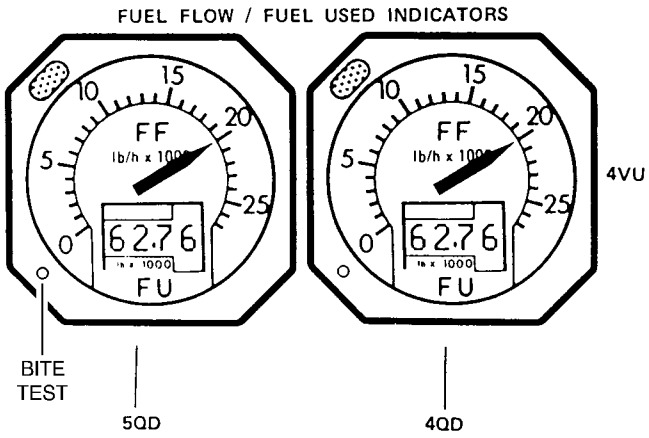
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
4QD	IND-FF/FU, ENG2	4VU	211		73-31-00
5QD	IND-FF/FU, ENG1	4VU	211		73-31-00
T2-46	TRANSMITTER-FUEL FLOW		452 462	452AR 462AR	73-31-11



Fuel Flow/Fuel Used Electrical Circuit
Figure 004

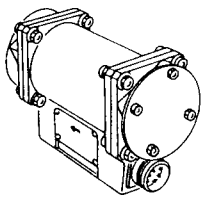


A



B

T2 - 46
TRANSMITTER
FUEL FLOW



BM5 73 31 00 0 KJS0 01

R Fuel Flow Indicating - Component Location
Figure 005

FUEL FLOW INDICATING - ADJUSTMENT/TEST

1. Reason for the Job

The test consists in checking fuel flow indication circuit.

2. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 71-00-00, P. Block 501	Power Plant - General

3. Procedure

A. Job Set-Up

(1)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(2)Make certain that electronics racks ventilation is correct.

B. Functional Test

ACTION	RESULT
1. Wet motor engine or run engine at idle (Ref. 71-00-00, P. Block 501, test No. 2 or test No. 3)	
During engine wet motoring or running	On FF indicator, check that fuel flow increases normally
Let engine completely shut down (0%N2) and make certain on panel 437VU that there is no starting air pressure.	
Place ignition selector switch in CRANK position.	
Press ENG/START(1) START(2) pushbutton switch	On panel 4VU, check that FUEL USED counter is reset
Place ignition selector switch in OFF position	

C. Indicator Test

ACTION	RESULT
1. On panel 4VU,	
R - maintain slot of BITE screw or Press-To-Test button, located in L lower section of FF/FU indicator or pressed in, respectively.	The fuel flow pointer moves to indicate a fuel flow value of 5400 Kg/Hr (12,000 PPH) marked by the blue spot on the edge of the dial face

D. Close-Up

(1)De-energize the aircraft electrical network (Ref. 24-41-00,

P. Block 301).

FUEL FLOW TRANSMITTER - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Access Platform
C.	Protective Covers
D.	Container Minimum Capacity of 1 U.s. Gallon (3.79 liters)
E.	Torque Wrench
F.	Corrosion Resistant Steel Lockwire (MS20995C32) (Ref. 70-00-00)
G.	Retainer
H.	Packings
I. Material No.P03-001	Oils (Ref. 70-00-00)
Referenced Procedure	
- 71-13-00, P. Block 301	Cowl Doors
- 73-31-00, P. Block 501	Fuel Flow - Indicating

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
FOR ENGINE 1			
133VU	ENGINES/ENG1 FF/FU	1QD	334/S68
FOR ENGINE 2			
133VU	ENGINES/ENG2 FF/FU	2QD	334/S75

(2)Install access platform.

(3)Open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

(1)Disconnect electrical connector DT580 from fuel flow transmitter and install protective covers on connector and receptacle.

(2)Remove lockwire from forward and rear bolts (1) and (2) securing transmitter. Remove bolts (2) and washers only.

(3)Remove bolts (3) securing support to fuel distribution valve. Remove support. Slide F3 transfer tube rearward to disengage from transmitter.

(4)Remove bolts (1) and washers. Disengage transmitter from F2 adapter. Remove transmitter from engine.

(5)Remove packings (4) and seal plates (5) and discard.

(6)Slide F3 transfer tube forward to disengage distribution valve. Remove packing (6) and discard.

(7)Install protective closures.

(8)If equipped loosen but do not remove bolts (7) from plate (8).

NOTE : Removed fuel flow transmitter must be preserved from corrosion. Refer to CMM - Shipping and storage preparation paragraph.

C. Installation

(1)Remove protective closures.

(2)Install packing (6), lubricated with Material No. P03-001, to groove at longer end of F3 transfer tube. Install tube into fuel distribution valve inlet port and slide rearward as far as possible.

(3)Install seal plates (5) to F2 adapter and to F3 transfer tube aligning index pins and index holes.

(4)Install packings (4), lubricated with Material No. P03-001, to grooves in F2 adapter and F3 transfer tube.

(5)Position transmitter to F2 adapter, aligning index pin and hole. Secure with bolts (1), threads lubricated with Material No.P03-001, and washers
R aligning bracket holes. TORQUE bolts (1) to between 65 and 85 lbf.in.
R (0.73 and 0.96 m.daN) and secure with lockwire.

(6)Slide F3 tranfer tube, with packing (4) and seal plate (5), forward aligning index pin and hole to engage outlet port of transmitter.

(7)Install support over F3 transfer tube. Secure to transmitter with bolts (2), threads lubricated with Material No. P03-001, and washers. TORQUE
R bolts (2) to between 65 and 85 lbf.in. (0.73 and 0.96 m.daN) and secure with lockwire.

(8)Install bolts (3), threads lubricated with Material No. P03-001, securing support and bracket to fuel distribution valve. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

(9)If equipped, tighten and TORQUE bolts (7) to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).

NOTE : Do not torque bolts (7) until flow meter is installed.

(10)Remove protective cover and install electrical connector DT580 on fuel flow transmitter. Tighten connector fingertight plus one-eighth turn.

D. Close-Up

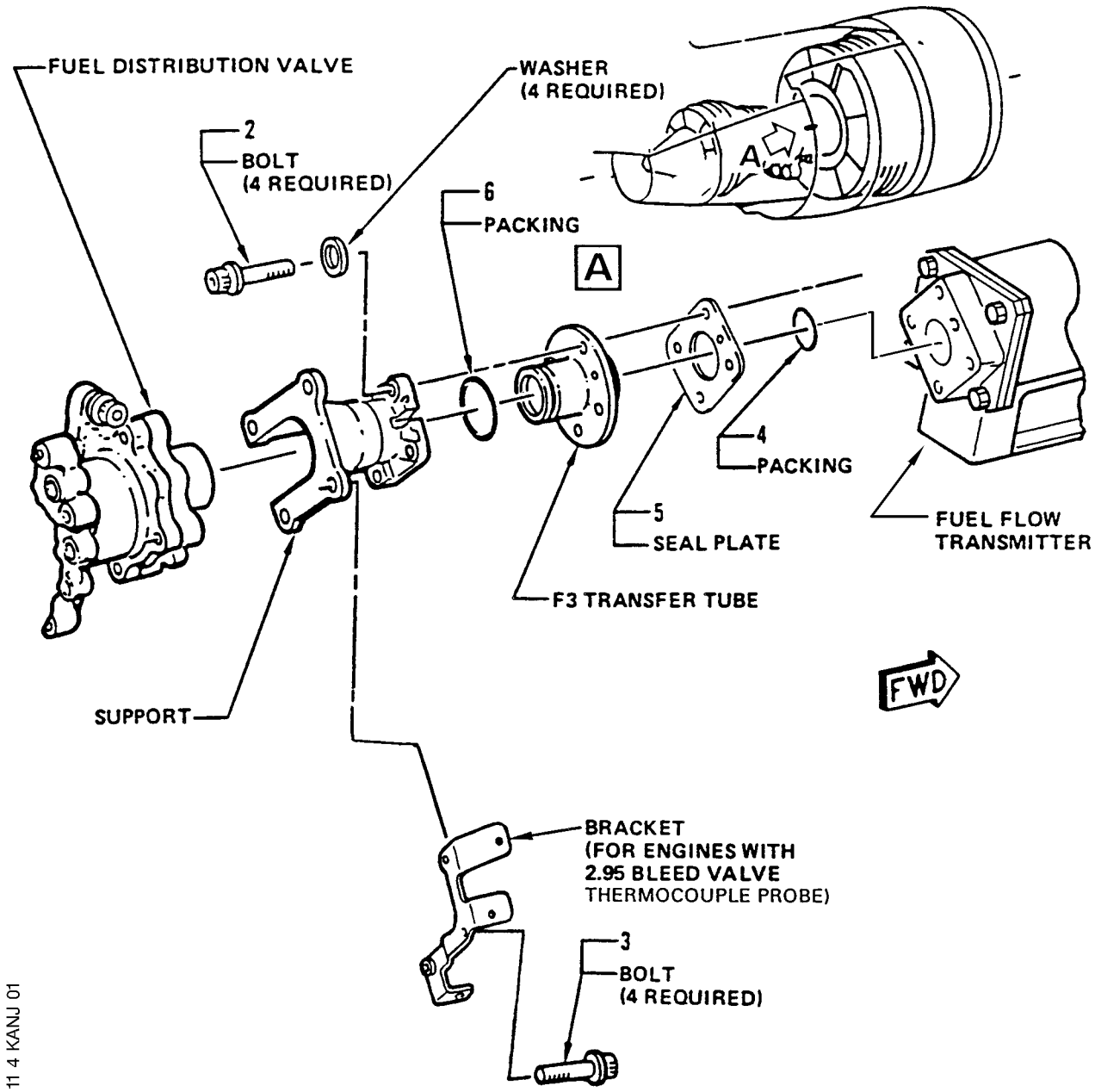
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

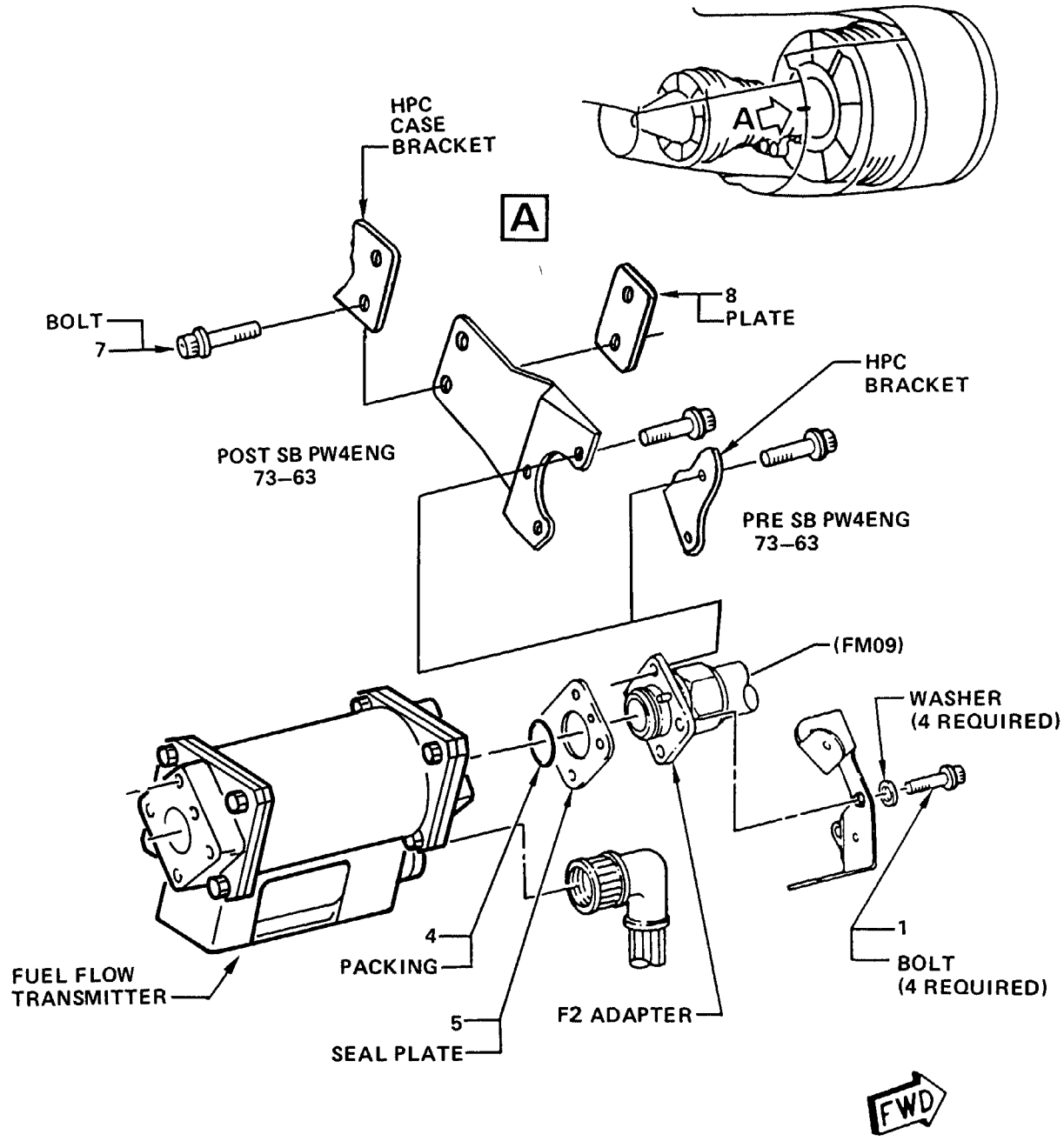
(3)Remove safety clips and tags and close circuit breakers : 1QD, 2QD.

(4)Remove access platform.

(5)Do a functional test of the fuel flow indication circuit (Ref. 73-31-00, P. Block 501).



Fuel Flow Transmitter (Sheet 1/2)
Figure 401



BM5 73 31 11 4 KANC - 00

Fuel Flow Transmitter (Sheet 2/2)
Figure 401

FUEL FLOW/FUEL USED INDICATOR - REMOVAL/INSTALLATION

NOTE : Removal/Installation procedures for FF/FU indicators on L and R engines are identical.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps/Plugs
Referenced Procedure - 73-31-00, P. Block 501	Fuel Flow Indicating

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

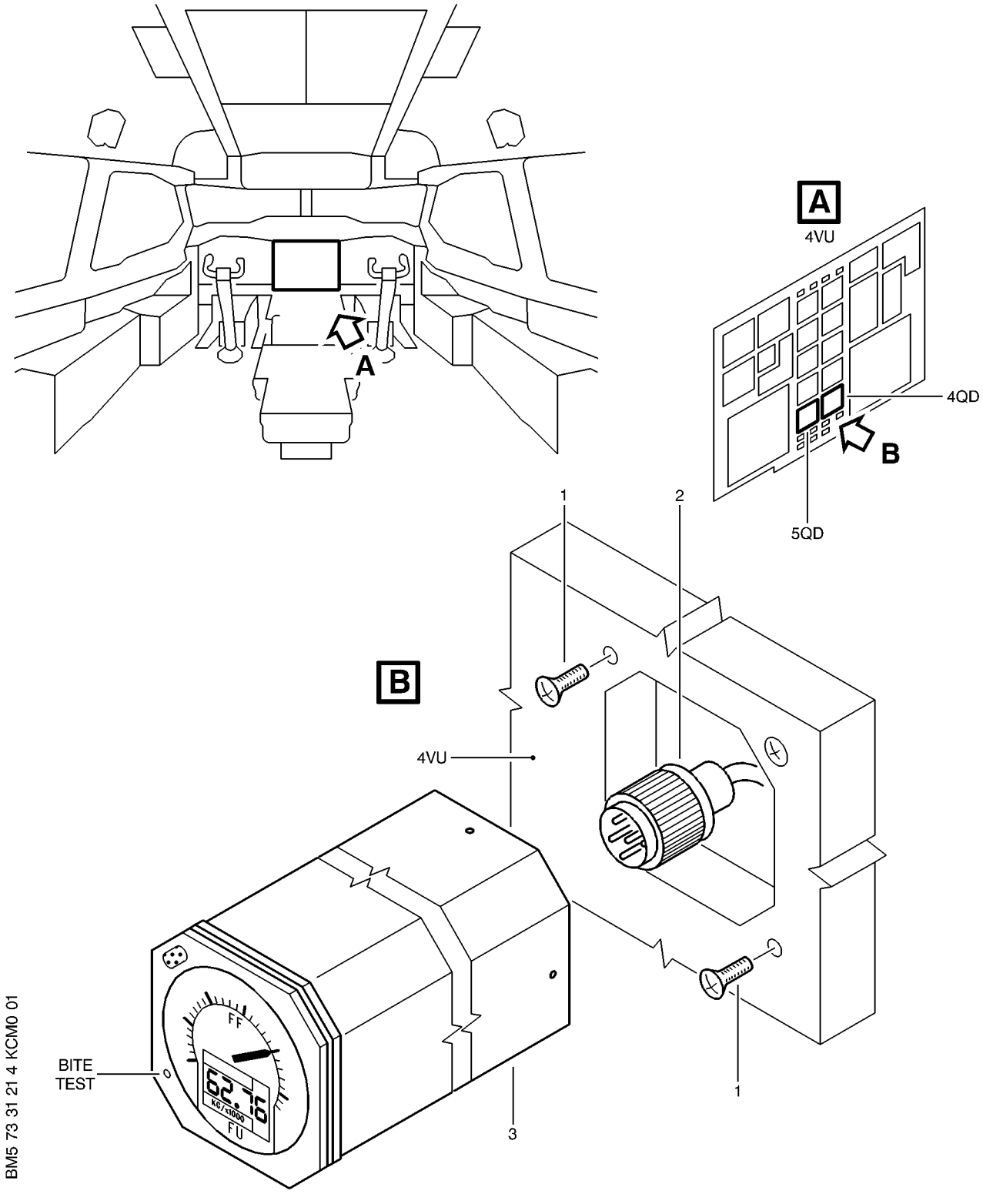
PANEL	SERVICE	IDENT.	LOCATION
133VU	ENGINES/ENG1 FF/FU	1QD	334/S68
133VU	ENGINES/ENG2 FF/FU	2QD	334/S75

B. Removal
(Ref. Fig. 401)
(1)On face of panel 4VU, remove two screws (1) attaching FF/FU indicator.
(2)Remove FF/FU indicator (3) from panel 4VU.
(3)Disconnect FF/FU indicator and blank off plug and receptacle (2).

C. Installation
(1)Check housing of FF/FU indicator on panel 4VU.
(2)Remove blanking caps from plug and receptacle (2) and connect plug.
(3)Install FF/FU indicator (3) in panel 4VU.
(4)Attach FF/FU indicator (3) to panel 4VU with two screws (1).
(5)Remove safety clips and tags and close circuit breakers 1QD and 2QD.

D. Test
Perform indicator test (Ref. 73-31-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Restore aircraft systems to normal operating condition.



FF/FU Indicator
Figure 401

R

FUEL PRESSURE - DESCRIPTION AND OPERATION

1. General

A. Fuel Pressure Transmitter (Ref. Fig. 001)

The fuel pressure (pump interstage) transmitter is located at the outlet of the fuel boost pump.
It transmits to the ECAM system a continuous signal proportional to fuel pressure.
The range of the indication is 0 to 350 psi.

B. Fuel Pressure Indicator (Ref. Fig. 002)

Fuel pressure, measured at the pump interstage, is displayed on the engine page on the right ECAM display unit.
The display form is analog (vertical scale) with digital definition adjacent to the vertical scale. The display range is between 0 and 350 psi.

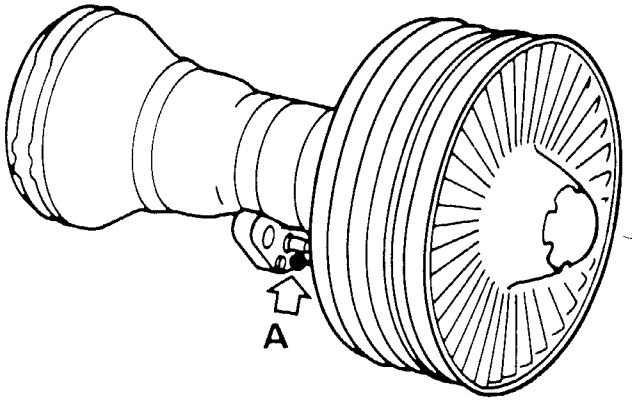
C. Electrical Circuit (Ref. Fig. 003)

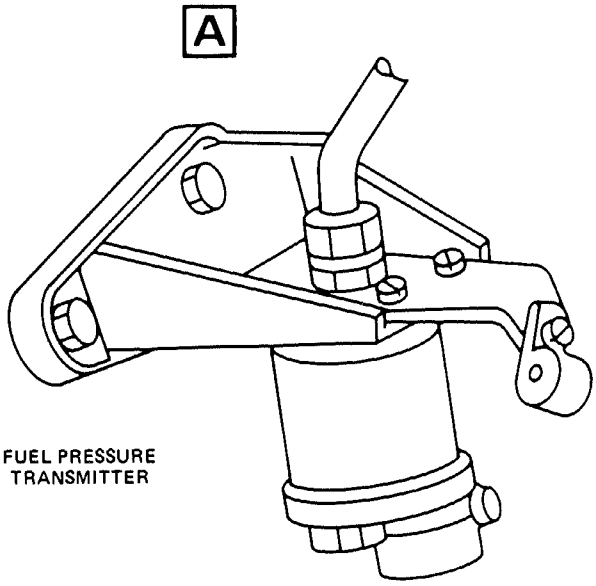
The fuel pressure sensors are powered by the Systems Data Analog Converter (SDAC), which is supplied from Normal and Essential Buses.
From the SDAC, the fuel pressure signals are routed and displayed on the right ECAM display unit.

2. Component Location

(Ref. Fig. 004)

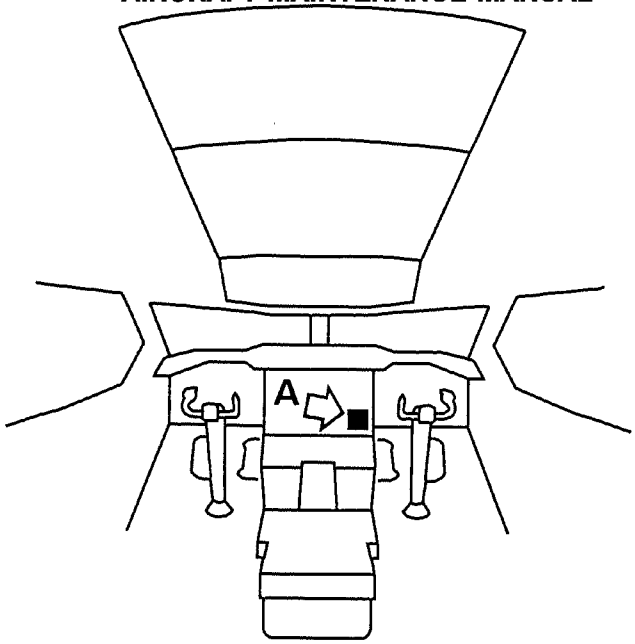
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
T581	TRANSMITTER - FUEL PRESSURE	452	452AR		73-33-11
		462	462AR		73-33-11

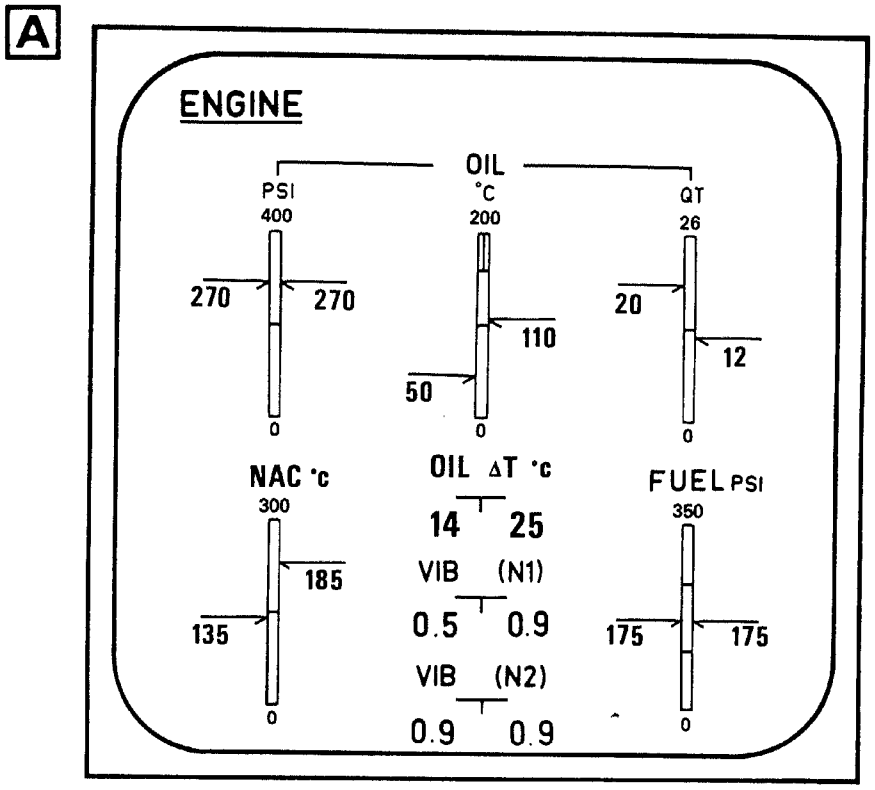




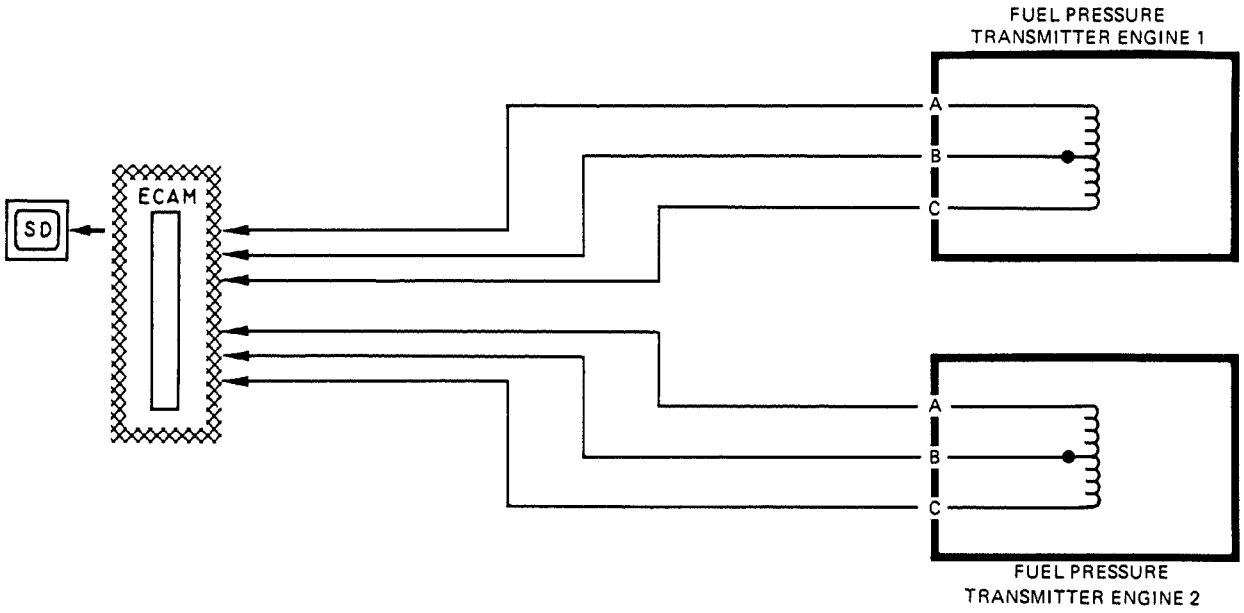
BM5 73 33 00 0 KAMO 23

Fuel System Pressure Indication
Figure 001



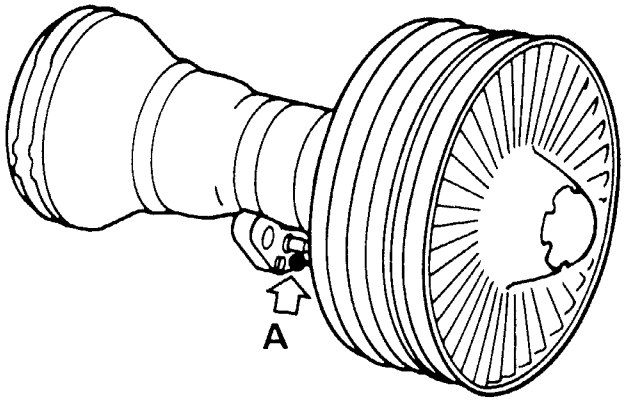


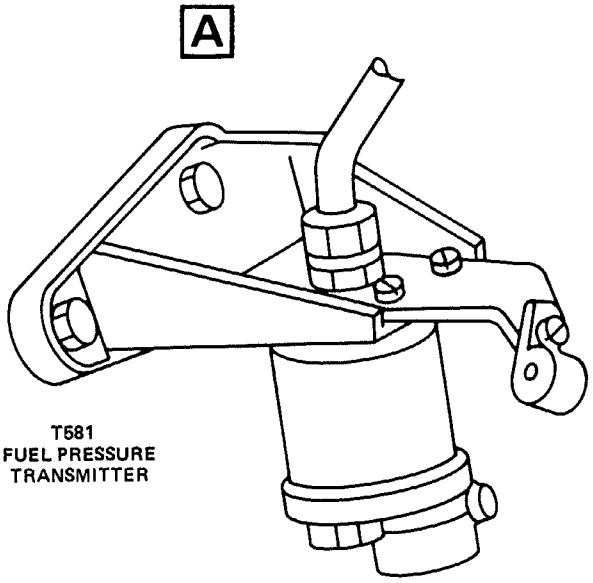
ECAM System Display
Figure 002



BM5 73 33 00 0 KEMO - 19

Fuel Pressure Indicating System
Figure 003





Fuel Pressure Transmitter Component Location
Figure 004

FUEL PRESSURE TRANSMITTER - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Covers
C.	Container Approximate Capacity of 1 U.S. Gallon (3.79 liters)
D.	Torque Wrench
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors

2. Procedure

A. Job Set-Up

(1) On the FIRE control module (overhead panel) of the engine concerned, pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(2) Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	ECAM/SDAC 26VAC REF2	3WV2	109/A02
21VU	ECAM/SDAC 26VAC REF3	5WV	109/A03
21VU	ECAM/SDAC SUPPLY	6WV	109/A05

(3) Open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

(1) Remove electrical connector from fuel pump interstage pressure transmitter and install protective covers on connector and receptacle.

WARNING : ENGINE FUEL IS A FIRE HAZARD. AVOID SPILLAGE AND MAKE SURE THAT FIRE EXTINGUISHING EQUIPMENT IS READILY AVAILABLE AND IN PROXIMITY TO THE WORK AREA. REMOVE ANY SPILLED FUEL IMMEDIATELY.

(2) Remove fuel tube assembly from transmitter union and drain residual fuel into suitable container.

(3) Remove union and packing from transmitter. Discard packing. Install protective covers on fuel tube coupling nut and transmitter.

R (4) Remove bleed plug from the transmitter and drain residual fuel into a suitable container.

R (5) Remove two screws and washers securing wire harness support bracket and transmitter forward mounting flange to transmitter support bracket. Remove wire harness support bracket.

R (6) Remove transmitter from transmitter support bracket by removing remaining two screws, washers and nuts.

C. Installation (Ref. Fig. 401)

(1) Position fuel pump interstage pressure transmitter on transmitter support bracket and install two screws, washers and nuts in transmitter aft mounting flange holes.

(2) Position wire harness support bracket on transmitter support bracket and install two screws and washers through transmitter forward mounting flange holes and into nutplates on wire harness support bracket. **TORQUE** screws to between 63 and 70 lbf.in. (0.71 and 0.79 m.daN).

(3) **TORQUE** transmitter aft mounting flange nuts to between 50 and 70 lbf.in. (0.56 and 0.79 m.daN).

R (4) Install the bleed plug on the fuel presssure transmitter. **TORQUE** the
R bleed plug to between 90 and 100 lbf.in. (1.02 and 1.13 m.daN).

R (5) Remove protective cover from pressure transmitter. Install union and new packing into pressure transmitter. **TORQUE** union to between 90 and 100 lbf.in. (1.01 and 1.13 m.daN).

R (6) Remove protective cover from fuel tube assembly coupling nut and connect to transmitter union. **TORQUE** coupling nut to between 135 and 150 lbf.in. (1.52 and 1.69 m.daN).

R (7) Remove protective covers and connect electrical connector DT581 to transmitter. Tighten connector fingertight plus one-eighth turn.

D. Close-Up and Test

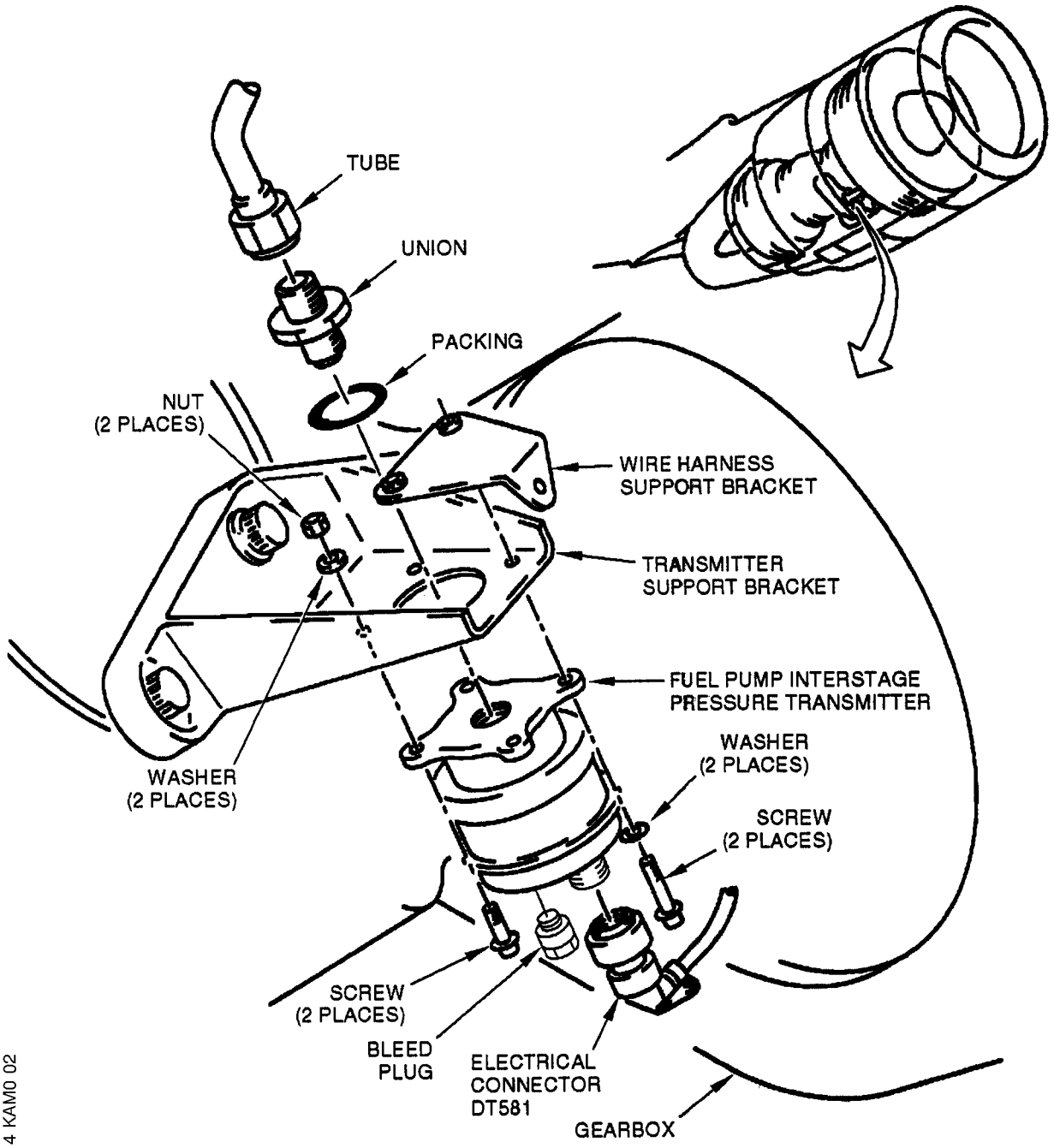
(1) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2) On the appropriate **FIRE** control module, push the fire handle and remove the warning notice.

(3) Remove safety clips and tags and close circuit breakers : 3WV2, 5WV, 6WV.

(4) Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).

(5) Test engine per test reference table (Ref. 71-00-00, P. Block 501).



BM5 73 33 11 4 KAM0 02

R

Fuel Pressure Transmitter
Figure 401

FUEL FILTER CLOGGING - DESCRIPTION AND OPERATION

1. General

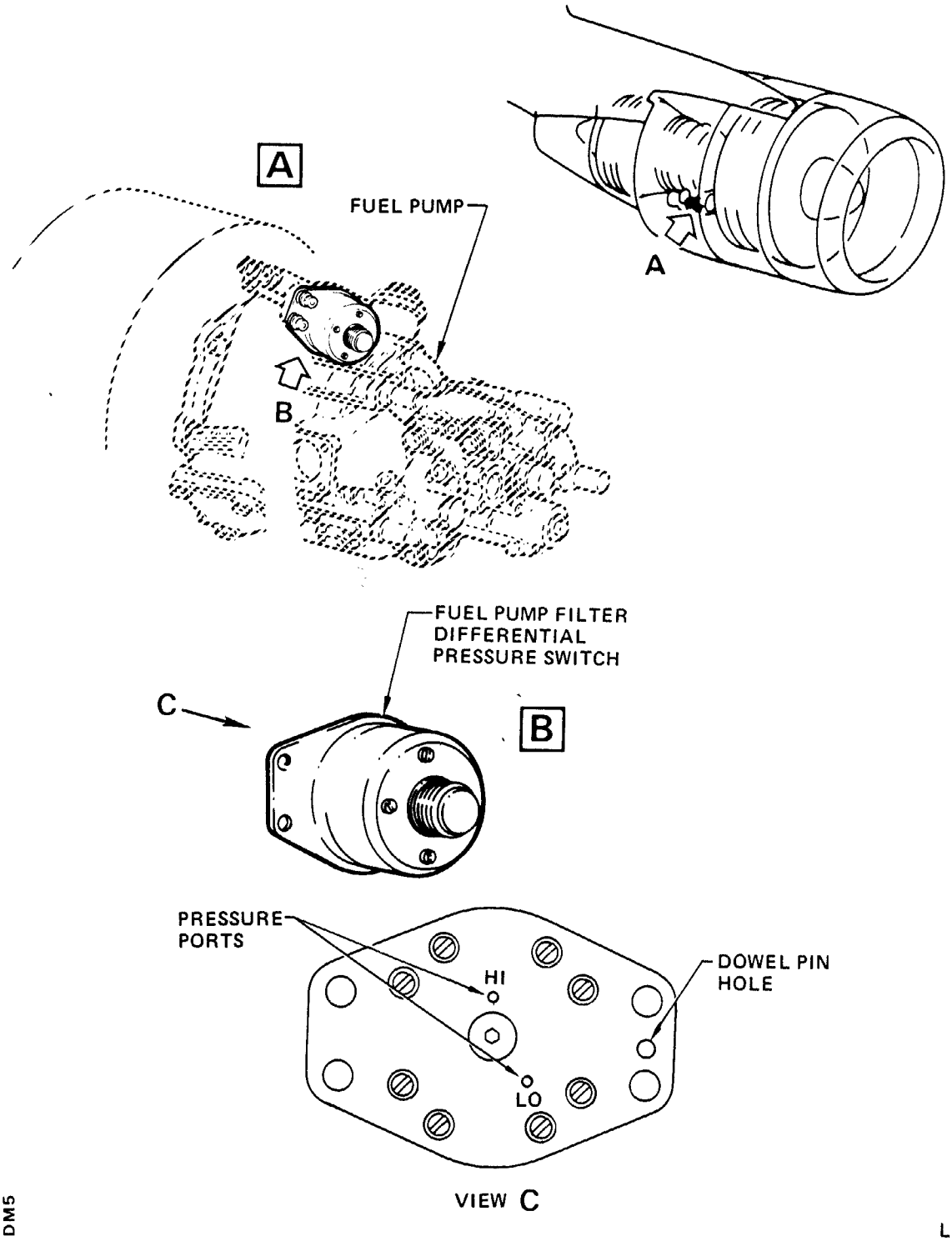
A. Fuel Filter Differential Pressure Switch (Ref. Fig. 001)
The fuel filter differential pressure switch is located on the fuel pump body, at the top of the fuel filter housing.
The fuel filter differential pressure switch senses the pressure drop across the fuel filter as an indication of flow restriction caused by the accumulation of ice or contamination particles in the fuel.
At a nominal pressure drop of 5.5 psid (0.38 bars), a flexible metal diaphram in the switch closes the switch contacts to trigger a warning in the flight compartment. When filter pressure drop decreases to 3.5 psid (0.24 bars) (nominal) the switch contacts open, removing the warning.

B. Indication (Ref. Fig. 002)
Switch contact closure activates the following warning indications :
- Amber **FUEL CLOG** warning light on panel 4VU
- Single stroke chime
- On main instrument panel, **MASTER CAUTION** lights
- On the L **ECAM** display unit, a warning message for crew member operation instruction.

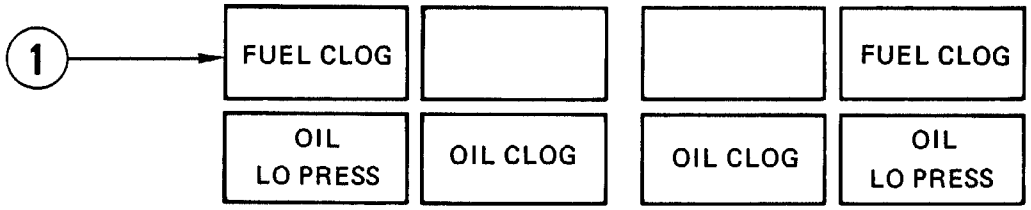
In the same time, the engine page is automatically called on the **R ECAM** display unit.

2. Component Location
(Ref. Fig. 003)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	SWITCH-FUEL FILTER DIFFERENTIAL PRESSURE	452 462	452AR 462AR		73-34-11 73-34-11



Fuel Pump Filter Differential Pressure Switch
Figure 001



1 - FUEL CLOG WARNING LIGHT (AMBER)

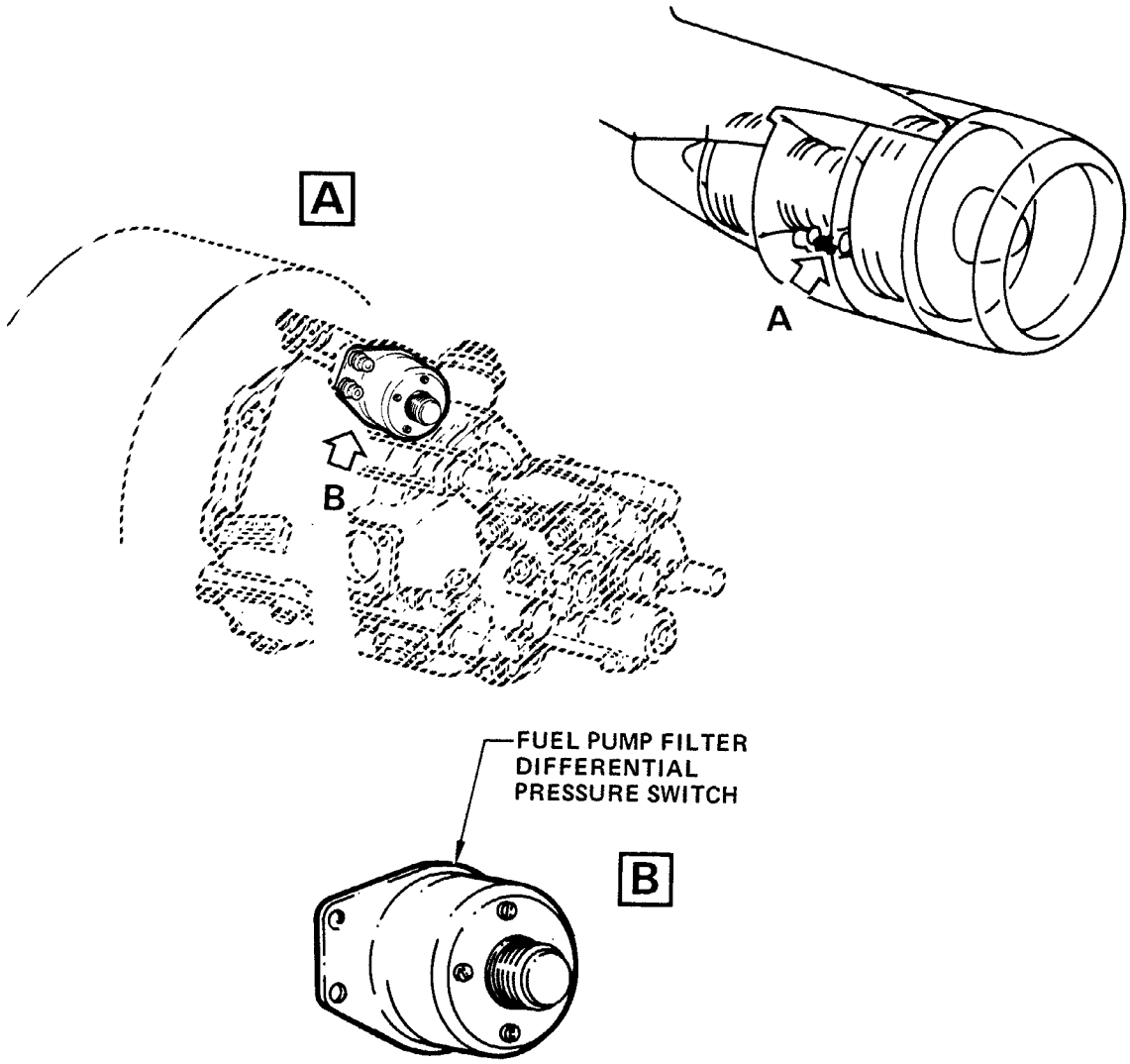
- COMES ON WHEN FUEL FILTER DIFFERENTIAL PRESSURE IS BETWEEN 4.8 AND 6.2 PSID IN INCREASING DIRECTION AND LIGHT OFF WHEN THE DIFFERENTIAL PRESSURE IS BETWEEN 25 AND 4.5 PSID

- ACCOMPANIED BY MASTER CAUTION LIGHT AND SINGLE STROKE CHIME

- WARNING MESSAGE APPEARS ON LEFT ECAM DISPLAY UNIT AND ENGINE PAGE ON RIGHT ECAM DISPLAY UNIT

BM5 73 34 00 0 KCMO -19

Fuel Clog Warning Light
Figure 002



BM5 73 34 00 0 KBMO - 00/29 - 00/24
DM5

Fuel Filter Differential Pressure Switch - Component Location
Figure 003

FUEL FILTER CLOGGING - ADJUSTMENT/TEST

1. Functional Test

A. Reason
The test consists in checking the operation of the fuel filter clogging system.

B. Equipment and Materials

ITEM	DESIGNATION
A. 66-201	Pressure Adapter (or equivalent)
B.	Gage, 0-10 PSIG (0-0.7 kg/cm²) ± 0.25 percent
C.	O-ring, ARP568-007
D.	Screw, 1/4-20 x 3/4 inch
E.	Valve, throttling
F.	Dry Compressed Air Source
G.	Warning Notice(s)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System
- 71-00-00, P. Block 501	General - Power Plant
- 71-13-00, P. Block 301	Cowl Doors
- 73-34-11, P. Block 401	Fuel Filter Differential Pressure Switch

C. Procedure
(1)Job Set-up
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301). Make certain that electronics racks ventilation is correct.
(b)Make certain that ECAM system is operating (Ref. 31-51-00, P. Block 1).
(c)On FIRE control module (overhead panel) of the engine concerned, pull fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress and to prohibit unwanted discharge of the bottle.
(d)On ECAM control panel, push CLR pushbutton switch to clear L ECAM display unit and select another page than ENGINE page on R ECAM display unit.
(e)Open, safety and tag circuit breakers for the appropriate engine and open thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).
R (f)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
R	FOR ENGINE 1		
133VU	ENGINES/ENG1 FUEL FILTER	1EL	331/V72
R	FOR ENGINE 2		
133VU	ENGINES/ENG2 FUEL FILTER	2EL	332/U72

R (g)Remove pressure switch from fuel pump (Ref. 73-34-11, P. Block 401).

NOTE : Keep electrical connector connected.

R (h)Position the two O-rings onto pressure adapter 66-201 and install pressure adapter onto pressure switch using the four screws. Connect high pressure port of pressure adapter to test set (Ref. Fig. 501).

(2)Test

ACTION	RESULT
1. Slowly supply high pressure port with compressed air to between 5 and 6 psid (0.35 and 0.41 bar)	Check that : - On panel 4VU, FUEL CLOG warning light comes on. - Single stroke chime sounds. - On main instrument panel, MASTER CAUTION light comes on. - On L ECAM display unit, a warning message for crew member instructions appears. - On R ECAM display unit, ENGINE page appears.
2. Slowly reduce pressure to between 3 and 4 psid (0.21 and 0.27 bar)	Check that : - On panel 4VU, FUEL CLOG warning light goes off. - On main instrument panel, MASTER CAUTION light goes off. - On L ECAM unit, message disappears. - On R ECAM unit, ENGINE page disappears.

(3)Close-up

(a)Stop air pressure and disconnect test set from pressure adapter.

(b)Remove pressure adapter from pressure switch.

(c)Install pressure switch onto fuel pump (Ref. 73-34-11, P. Block 401).

(d)On overhead panel, push the fire handle of the appropriate FIRE control module, and remove warning notice.

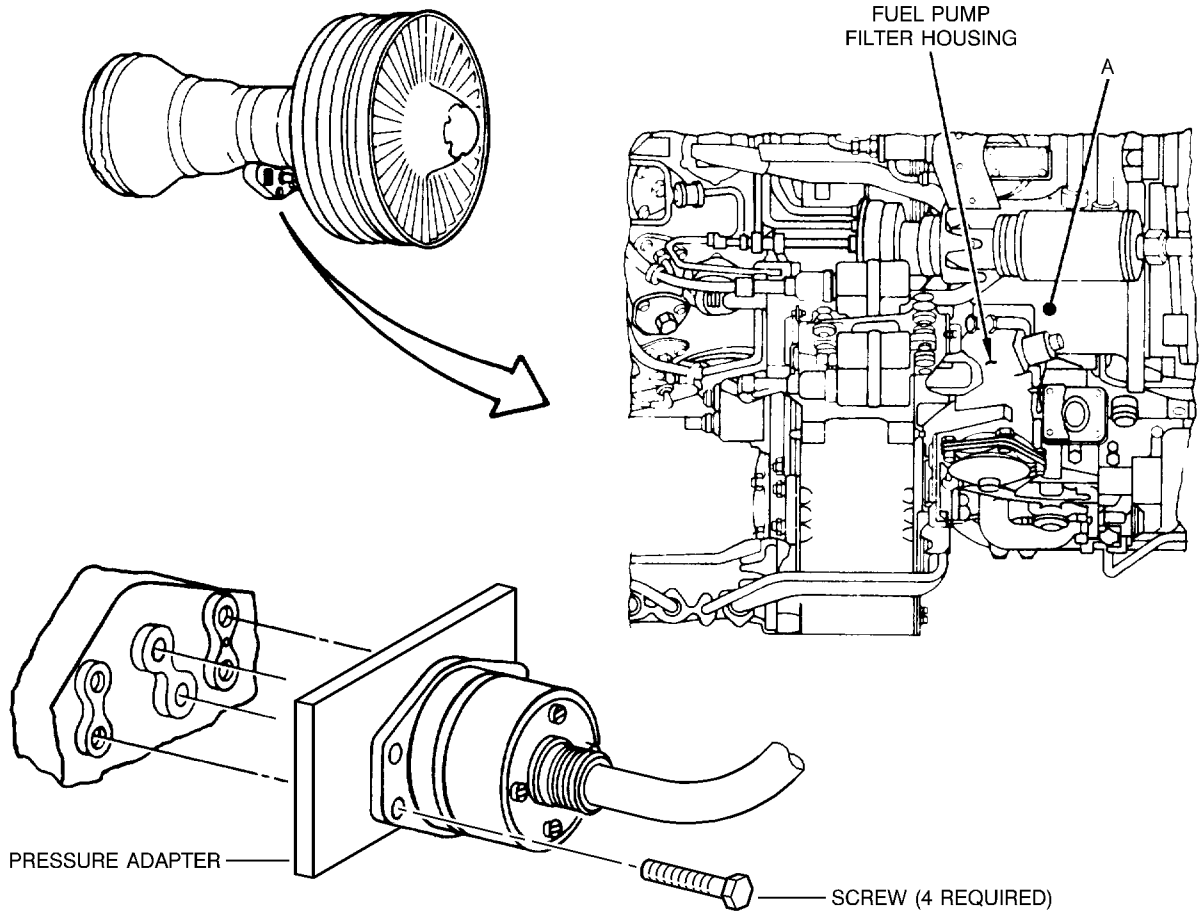
(e)Remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

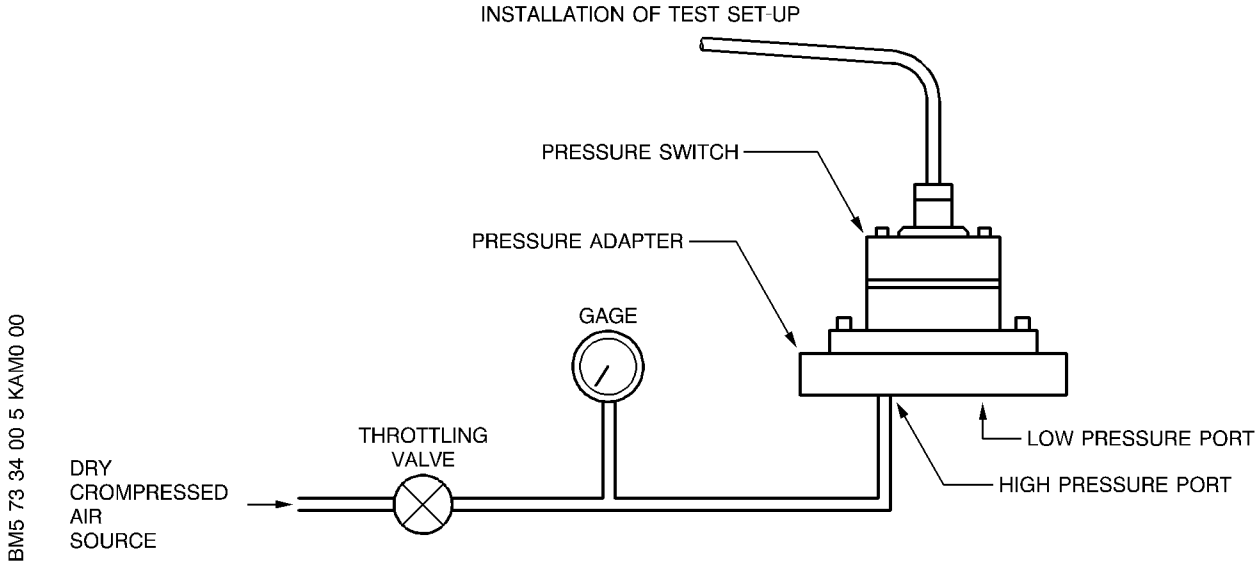
(f)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).

(g)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(h)Close thrust reverser and fan cowl doors. Remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

(i)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).





Test Set Installation
Figure 501

FUEL FILTER CLOGGING - DEACTIVATION/REACTIVATION

Ref. : MMEL Section 1-73, Item 8 ("FUEL CLOG" lt.)

1. Deactivation

A. Reason for the Job

Failure of fuel filter clogging indicating system.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Warning Notices
(2)	Circuit Breaker Safety Clips
Referenced Procedures	
- 71-00-00, P. Block 501	Power Plant - General
- 71-13-00, P. Block 301	Cowl Doors
- 73-12-03, P. Block 401	Fuel Filter

C. Procedure

WARNING : BEFORE UNDERTAKING MAINTENANCE OPERATIONS ON FUEL SYSTEM, MAKE CERTAIN THAT FIRE FIGHTING EQUIPMENT IS READILY AVAILABLE AND IN PROXIMITY TO THE WORK AREA.

(1) Job Set-Up

(a) Open, safety and tag the appropriate circuit breakers and open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

(2) Procedure

(a) Remove the fuel filter element (Ref. 73-12-03, P. Block 401).

(b) Visually inspect fuel filter element. Record the degree and nature of excessive residue.

(c) If the fuel filter element is contaminated, refer to TSM 72-00-40.

(d) Install a new fuel filter element (Ref. 73-12-03, P. Block 401).

NOTE : Do not use or clean the same fuel filter element again.

(3) Close-up

(a) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(b) Close thrust reverser and fan cowl doors. Remove safety clips and tags and close circuit breakers (Ref. 71-13-00, P. Block 301).

R (c) Perform a dry motoring (Ref. 71-00-00, P. Block 501 ; Test No.2) or
R an idle power ground test (Ref. 71-00-00, P. Block 501 ; Test No.3) or
R an idle leak check (Ref. 71-00-00, P. Block 501 ; Test No.3A).

(d) Open fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301) and check for leakage. Close thrust reverser and fan cowl doors.

(e) Install a warning notice in the flight compartment indicating that Eng. 1 (2) fuel filter clogging indicating system is inoperative.

2. Reactivation

Refer to TSM 71-04 ; 73-30-40.

FUEL FILTER DIFFERENTIAL PRESSURE SWITCH REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Protective Closures
C.	Torque Wrench
D.	Packings
E.	Container (minimum capacity 5 U.S. Gallons (19 liters))
F.	Bergen Mechanical Crimper (Optional) Model M303, M305 or M307
G. Material No.P03-001	Oils (Ref. 70-00-00)
H. Material No.P05-289	Special Materials (Ref. 70-00-00)
J. Material No.P05-291	Special Materials (Ref. 70-00-00) (Optional)
K. Material No.P05-292	Special Materials (Ref. 70-00-00) (Optional)
L. Material No.P06-002	Lubricants (Ref. 70-00-00)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 71-13-00, P. Block 301	Cowl Doors
- 71-00-00, P. Block 501	Power Plant - General

2. Procedure

A. Job Set-Up

(1)Energize the aircraft electrical network (Ref. 24.41.00, P. Block 301).

(2)On the FIRE control module (overhead panel) of the engine concerned pull the fire handle and install a warning notice to prohibit actuation in normal position (pushed) while maintenance is in progress.

(3)Open, safety and tag circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
FOR ENGINE 1			
133VU	ENGINES/ENG1 FUEL FILTER	1EL	331/V72
FOR ENGINE 2			
133VU	ENGINES/ENG2 FUEL FILTER	2EL	332/U72

(4)Open the fan and thrust reverser cowl doors (Ref. 71-13-00, P. Block 301).

B. Removal (Ref. Fig. 401)

(1)Disconnect electrical connector. Install protective closures.

WARNING : DO NOT LET ENGINE FUEL STAY ON YOUR SKIN FOR A LONG TIME. THE FUEL IS POISONOUS AND CAN GO THROUGH YOUR SKIN. PUT A CONTAINER, MINIMUM CAPACITY OF FIVE U.S. GALLONS (19 LITERS), IN POSITION AND COLLECT THE DRAINED FUEL.

(2)Remove the lockwire or safety cable and plug from the center of the fuel pump filter cover. Let the fuel drain from the filter housing. Discard the packing from the plug.
(3)Install the packing lubricated with Petrolatum White (Material No.P06-002), to the plug. Lubricate threads of the plug with Engine Oil (Material No.P03-001) and install the plug to the center opening on the filter cover. TORQUE the plug to between 45 and 55 lbf.in. (0.51 and 0.62 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the plug.
(4)Remove bolts and washers securing switch to fuel pump. Remove switch and bracket if equipped and discard packings. Install protective closures.

C. Installation (Ref. Fig. 401)
(1)Remove protective closures.
(2)Using two new packings, lubricated with Petrolatum White (Material No.P06-002), position differential pressure switch on fuel pump aligning dowel pin.
(3)Secure switch and bracket (Post SB PW4ENG 73-84) with bolts, threads lubricated with Engine Oil (Material No.P03-001), and washers (Ref. Fig. 401). TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).
(4)Connect electrical connector. Tighten handtight.

R **ON A/C 101-105,

R Post SB 71-2024 For A/C 101-105,

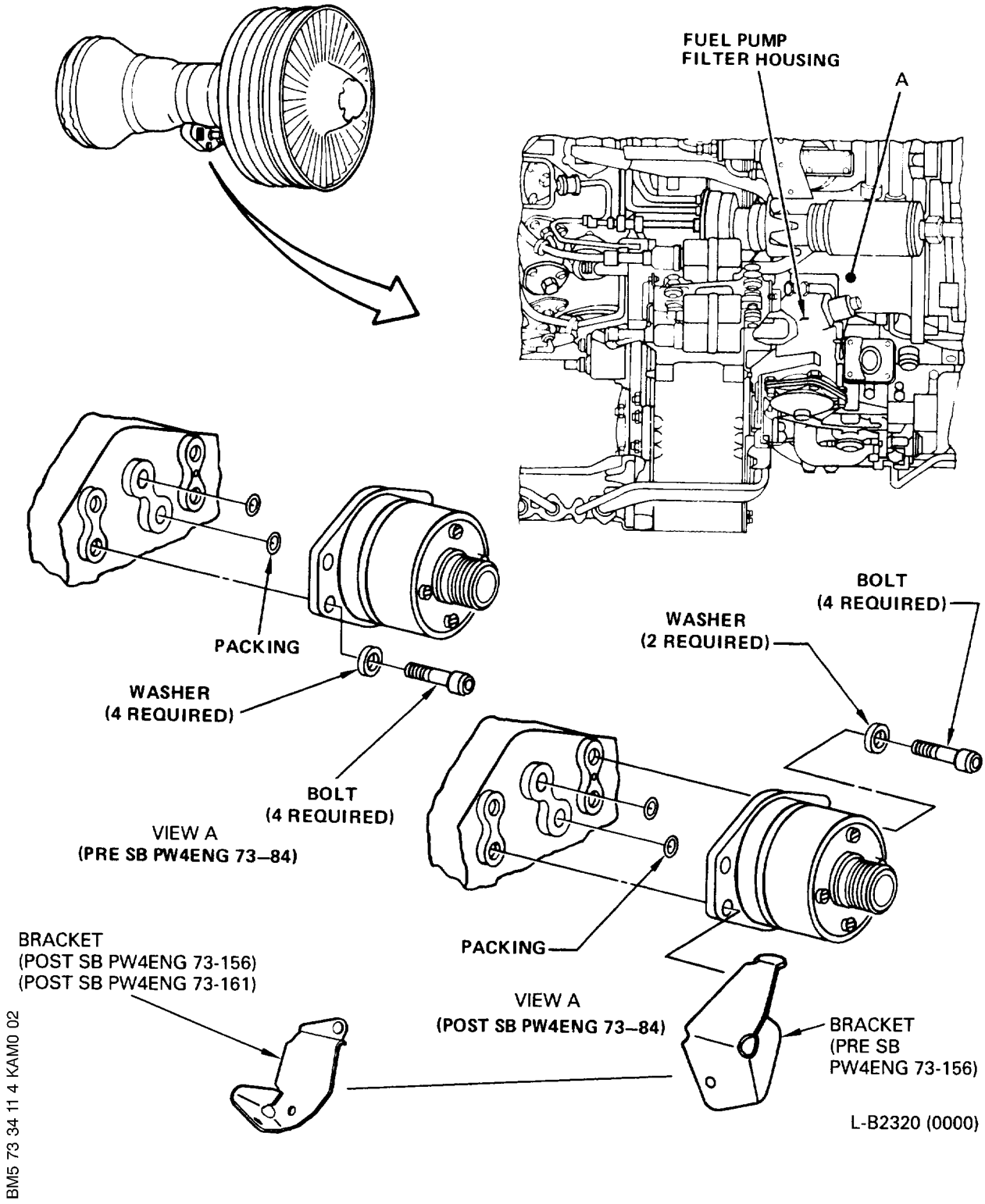
B. Removal (Ref. Fig. 402)
(1)Disconnect electrical connector. Install protective closures.
WARNING : DO NOT LET ENGINE FUEL STAY ON YOUR SKIN FOR A LONG TIME. THE FUEL IS POISONOUS AND CAN GO THROUGH YOUR SKIN. PUT A CONTAINER, MINIMUM CAPACITY OF FIVE U.S. GALLONS (19 LITERS), IN POSITION AND COLLECT THE DRAINED FUEL.
(2)Remove the lockwire or safety cable and plug from the center of the fuel pump filter cover. Let the fuel drain from the filter housing. Discard the packing from the plug.
(3)Install the packing lubricated with Petrolatum White (Material No.P06-002), to the plug. Lubricate threads of the plug with Engine Oil (Material No.P03-001) and install the plug to the center opening on the filter cover. TORQUE the plug to between 45 and 55 lbf.in. (0.51 and 0.62 m.daN). Install the Lockwire (Material No.P05-289) or the Safety Cable (Material No.P05-291) and Safety Cable Ferrule (Material No.P05-292) to safety the plug.
(4)Remove bolts and washers securing switch to fuel pump. Remove switch and bracket and discard packings. Install protective closures.

C. Installation (Ref. Fig. 402)

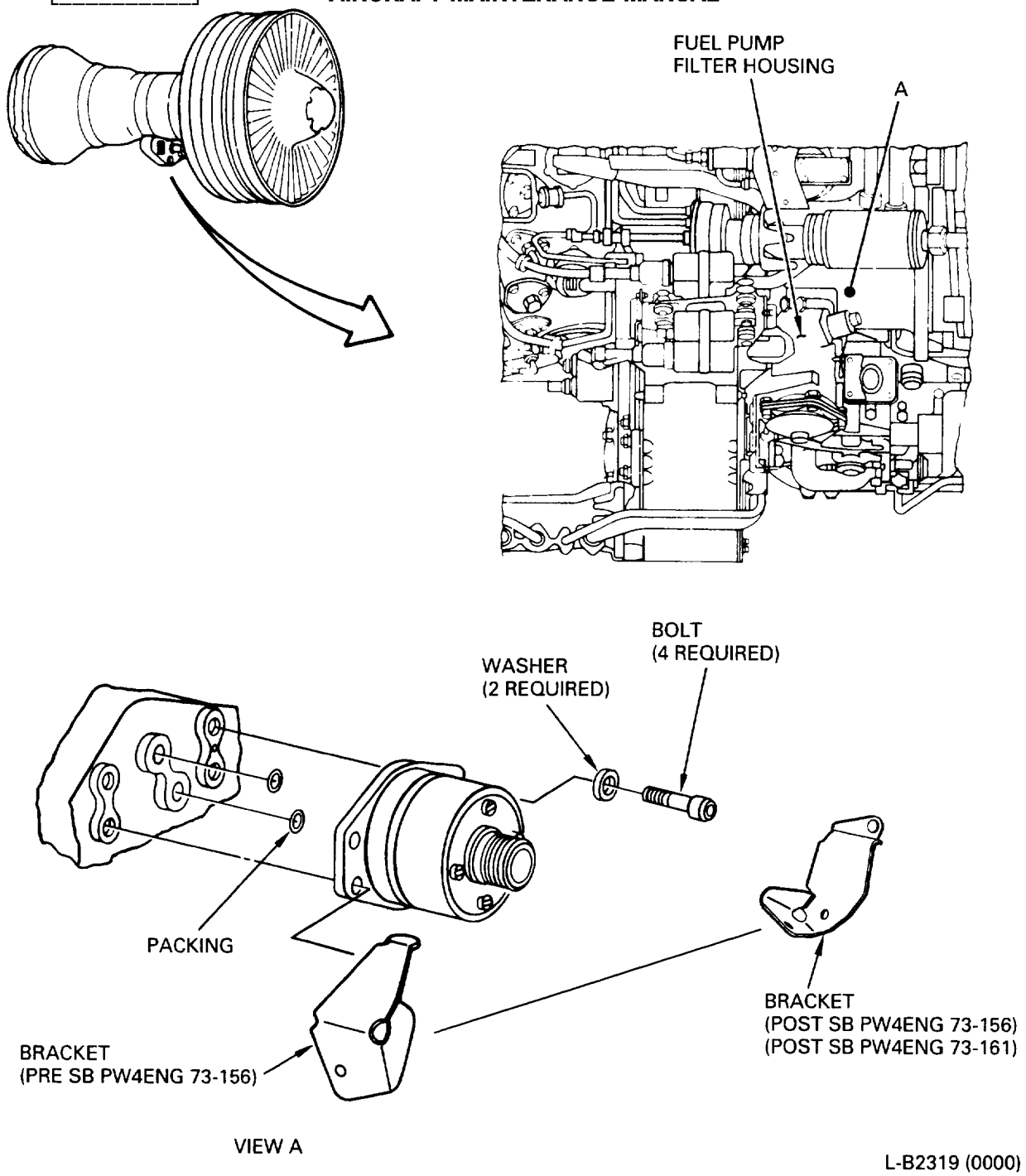
(1)Remove protective closures.
(2)Using two new packings, lubricated with Petrolatum White (Material No.P06-002), position differential pressure switch on fuel pump aligning dowel pin.
(3)Secure switch with bolts, threads lubricated with Engine Oil (Material No.P03-001), a bracket angle outward and forward and washers under boltheads at remaining two locations. TORQUE bolts to between 85 and 95 lbf.in. (0.96 and 1.07 m.daN).
(4)Connect electrical connector. Tighten handtight.

**ON A/C 101-200,

D. Close-Up and Test
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)On the appropriate FIRE control module, push the fire handle and remove the warning notice.
(3)Close thrust reverser and fan cowl doors (Ref. 71-13-00, P. Block 301).
(4)Remove safety clips and tags and close circuit breakers : 1EL, 2EL.
(5)Test engine per Test Reference Table (Ref. 71-00-00, P. Block 501).
(6)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).



Fuel Filter Differential Pressure Switch
Figure 401



BM5 73 34 11 4 KAP0 00

Fuel Filter Differential Pressure Switch
Figure 402

FADEC SYSTEM INDICATING - DESCRIPTION AND OPERATION

1. General

The FADEC system is a source of aircraft data in addition to the fuel system indications. The flight compartment information provided by the FADEC system are the following :

- actual EPR
- command EPR
- exhaust gas temperature : EGT
- N1 speed
- N2 speed
- system status advisories.

All these information are digital with the exception of the N1 and N2 speed and sent by the output buses.

- N1 speed is an analog signal actively buffered by channel B of the FADEC.
- The analog N2 speed signal goes directly from the dedicated winding in PMA to the flight compartment indicator.

In addition to the information listed, all other parameters on FADEC digital output buses can be recorded by an optional Aircraft Integrated Data System (AIDS) for future analysis.

2. System Status Advisories

The FADEC provides the aicraft warning system with discrete information contained in the serial digital data bus. These system status advisories are used to inform the crew in the following cases :

- when dispatch is affected
- when a crew action is required
- when the engine operation is affected.

For other failures on the FADEC system with no impact on immediate engine operation, due to the FADEC fault tolerance capability, general maintenance message will be given at the end of the flight, if the next following dispatch is affected.

FAULT LEVEL	DISPATCH CRITERIA	TRIGGERED BY LABEL/BIT
A	NOT DISPATCHABLE	350/16
B	DISPATCHABLE	350/17
C	DISPATCHABLE	350/18

Fault level A : (ECAM message "FADEC CHANNEL A (or B) FAULT").
The maintenance actions have to be done before the next flight.

Fault level B : (ECAM message "FADEC MINOR FAULT").
The maintenance actions have to be done as soon as the repair is possible but in a period of time not exceeded 20 days.

Fault level C : (No ECAM message).
The FADEC level C fault messages must be read and corrected within 1000FH.

| NOTE : Refer to TSM 73-21-40 for maintenance actions. |

3. Messages

A message on the left ECAM display unit, associated to the master CAUTION light and single chime is given in the following failure cases.

A. Overspeed

An overspeed in N1 or N2 has been detected by the FADEC, and the engine control has reverted to the minimum fuel flow until a reset occurs.

B. Alternate Mode Reversion

The engine control has reverted to N1 mode due to its inability to control the engine in primary mode : EPR. The message will be associated to a local fault light on the ENGINE panel (overhead panel 429VU). This automatic reversion is done with a trim, locked at the time of the reversion, used to prevent a thrust loss. After a throttle reduction, the crew can confirm the N1 mode and remove the trim.

A mode recovery logic allows to reselect the EPR mode if the air data fault which caused the reversion is no longer present.

Remark : In case of manual selection of the alternate mode, a simple message, to perform the power setting manually, is given with no MASTER CAUTION and no chime.

C. Reverser in Flight

The FADEC has controlled the engine at idle after detection of a non commanded thrust reverser deployment.

D. FADEC Channel A (or B) Fault

This indication may be given before the take-off phase to advise the crew that the FADEC system on the relative engine and channel is not dispatchable. The same warning may be used as a FADEC health indication after landing to indicate that a fault has occurred during the flight, with operational impact but which could affect the next dispatch.
(Ref. Para. 2. above).

E. FADEC Minor Fault

The indication is given after landing that future dispatchability may be affected due to a FADEC system time limited fault. All the items, identified by the FADEC, for which the engine operation is limited are listed in maintenance manuals with their associated limitations.
(Ref. Para.2.above).

NOTE : When the A/C is powered from batteries, the performance solenoids are not energized. This might lead to a FADEC MINOR FAULT message on the ECAM.

F. Throttle Lever Position Fault

A warning is given for the two fault accommodations on TLA which affect the engine behaviour :

- Throttle control lever position frozen at the value reached before the failure identification. In this case, if a reset occurs, the TLA is then

frozen at idle for the rest of the flight.
- TLA frozen in failsafe position : idle ; after a fault detection on the ground.

4. Ground Test

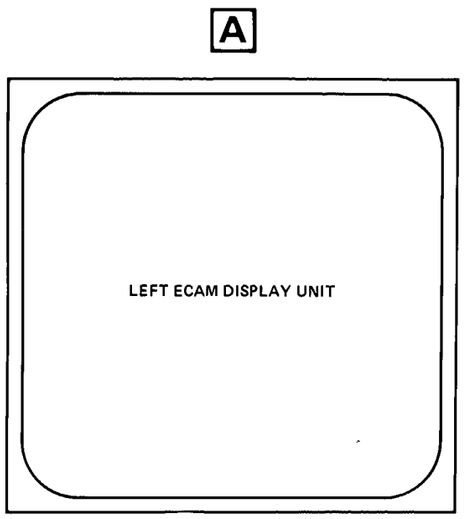
A. General
Aircraft electrical power can be connected to power the engine control system of each engine for testing purposes when the engine is not rotating. This mode is possible on the ground only ; it helps the troubleshooting and allows identification of the failed LRU on the system.

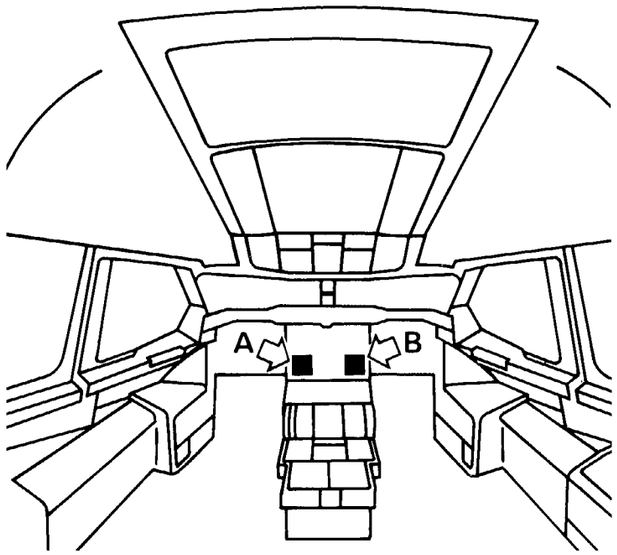
B. Test Mode (Ref. Fig. 003, 004)
(Ref. Fig. 001)
Selection of this power is made in flight compartment by activation of ENG/FADEC/BITE DISPLAY/TEST switch (Position : "TEST").
FADEC GTP is supplied via SCU by normal busbar 1PP when HP fuel shut off valve control lever is turned on and by essential busbar 3PP when HP fuel shut off valve control lever is turned off.
After the ground test power up and its initialization, the FADEC transmits on digital output buses the current status for each parameter at the time of test.
When initiated, the test allows display on the ECAM system of parametric data, status and maintenance words from the two channels of the selected FADEC.
Parametric data is displayed on the right ECAM unit and status and maintenance words in hexadecimal form on the left ECAM display unit.
Normally the ADC will be powered and operating during ground tests. ADC outputs will reflect the ambient conditions that exist. If the ADC is not powered, the serial digital data bus will be inactive, and the FADEC'S ADC interface will be flagged as failed.
Normally the TCC will be powered and be operating during ground test. TCC outputs will reflect the existing aircraft configuration. If the TCC is not powered, the serial digital data bus will be inactive and the FADEC'S TCC interface will be flagged as failed.

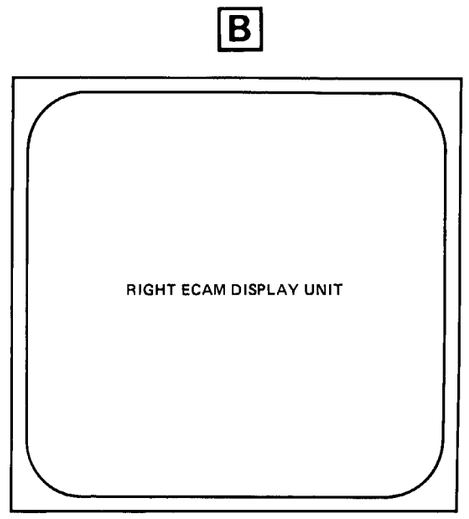
(Ref. Fig. 002)

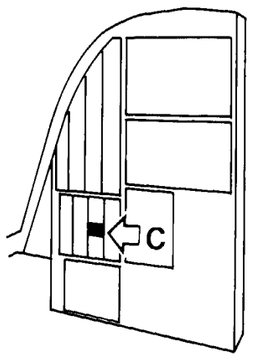
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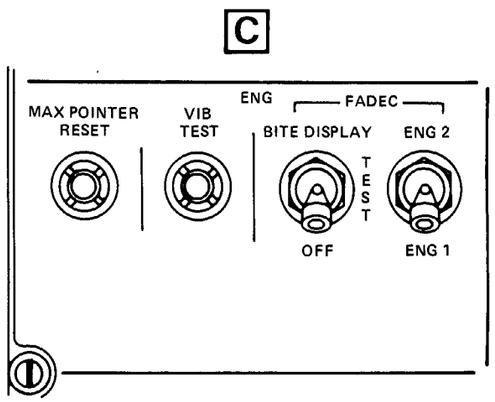
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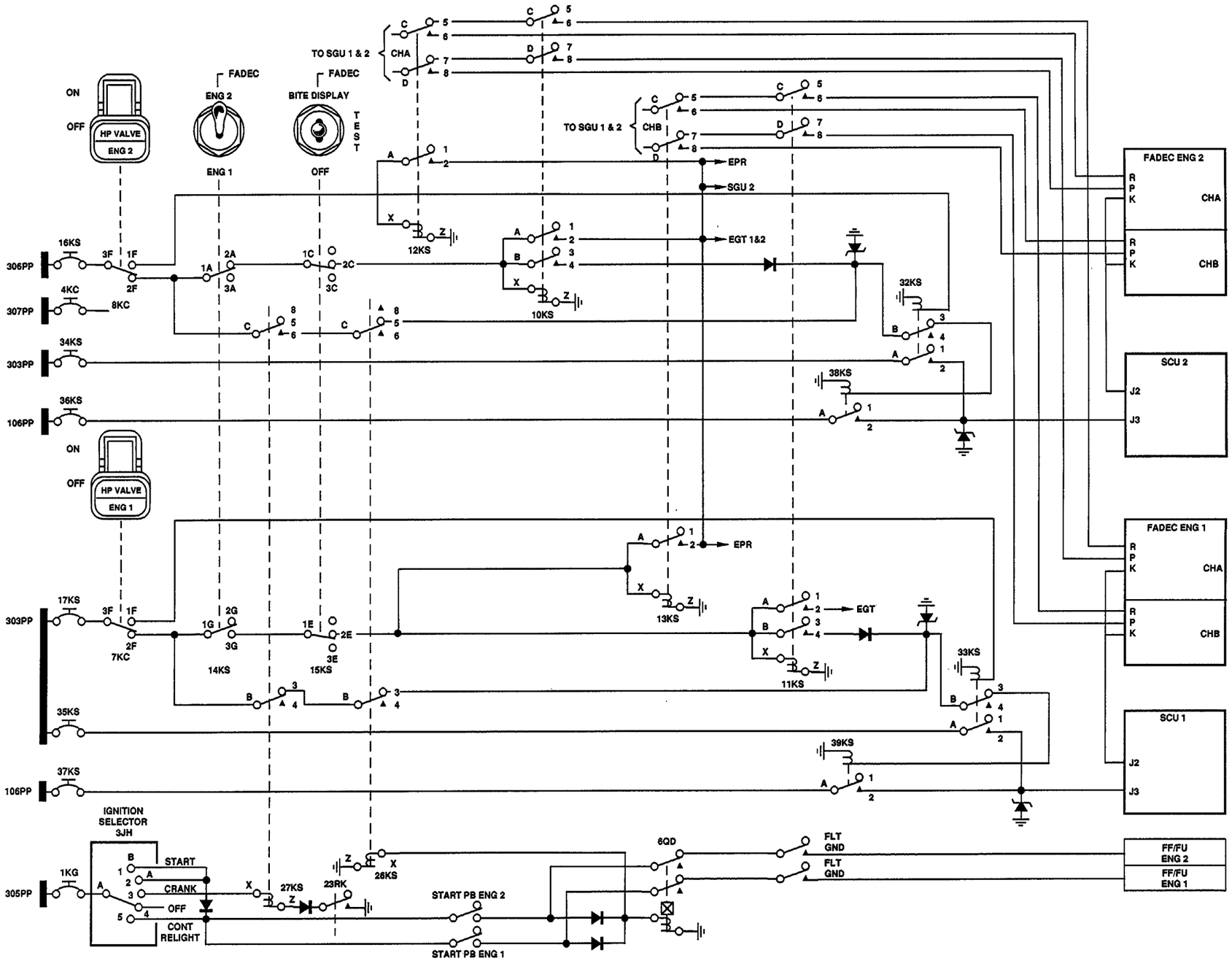






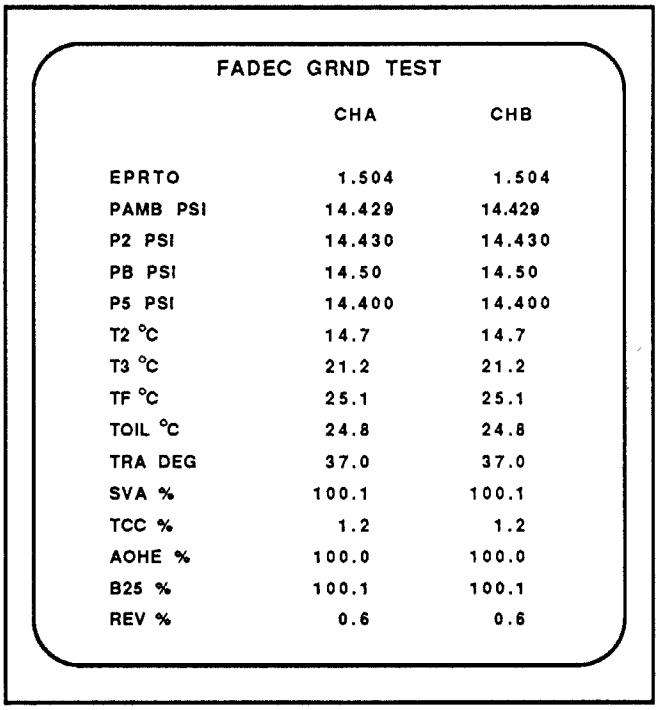
BM5 73 38 00 0 KAMO 15

Ground Test
Figure 001

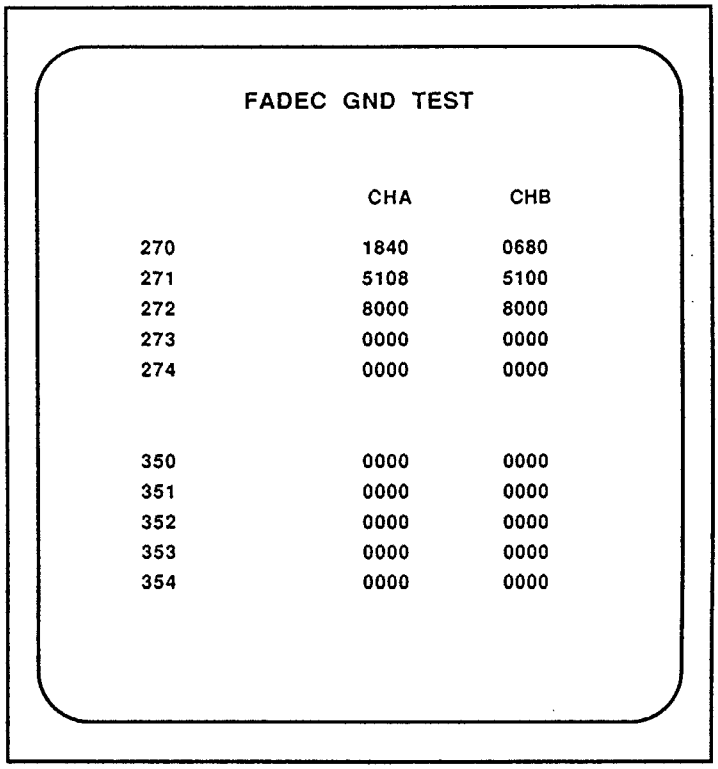


BM5 73 38 00 0 KGPO - 00

Ground Test - Electrical Circuit
Figure 002



Right Ground Test Display
Figure 003



BM5 73 38 00 0 KEPO - 00

Left Ground Test Display
Figure 004

5. BITE Display

A. General
(Ref. Fig. 001)
The FADEC incorporates a maintenance data storage and retrieval system to assist trouble shooting. This system stores in a non volatile memory, those in-flight faults occurring when the engines are running or in particular flight conditions, together with the environmental conditions prevailing at the time.
When this system is activated during the ground test by a selection on the maintenance panel of the BITE display mode (Ref. 73-25-00), it is possible to display on ECAM system the maintenance words encoded from the non volatile memory and the delta corresponding flight leg.
Remark : In addition to the information displayed, the non volatile memory stores some environmental conditions at the time of the failure to assist the shop maintenance personnel : flight leg, Mn, N2, P2, CJC, fault time.

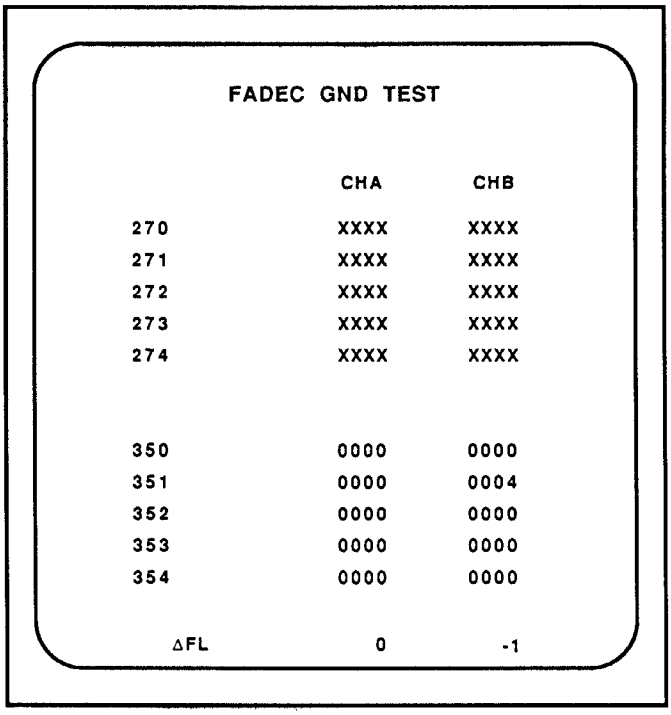
B. Retrieval Mode
This mode once initiated will search the fault memory for the failure or failures occurring in the most recent flight leg. These failures will then be encoded into the ARINC 350 word format and transmitted. The delta between the current flight leg counter and the flight leg bits in the fault cell(s) is calculated and transmitted via label 302. This word will indicate to the ground test personnel how many flight legs ago the reported fault(s) occurred. The control continues to transmit this set of 350 words and the 302 word at an approximate rate of 200 milliseconds until the enabling conditions are changed or until the maintenance discrete is cycled. If the maintenance discrete is cycled, the FADEC will step back to the next most recent flight leg data and report it and the delta flight leg data in the same manner as the first. This process of stepping back through the faults will continue until all recorded faults are reported.
This retrieval is not possible during engine control. The logic is prohibited from entering in this mode by a number of interlocks including :
- maintenance test initiation (ground test power, no N1, no N2 and low Mn).
- external reset indicating a closed switch (fuel off).
- maintenance discrete set (selection of BITE display).

C. Display (Ref. Fig. 005)
In the on-wing retrieval, only the maintenance words and the delta flight leg, from the two channels, are displayed on the left ECAM display unit in hexadecimal format.

**ON A/C 101-200,

R Post SB 73-2029 For A/C 101-200,

6. Alternate Playback Mode



BM5 73 38 00 0 KJMO 19

Left ECAM Display BITE Test
Figure 005

A. This mode retrieves and displays fault messages from EEC memory which cannot be located by using the normal FADEC BITE DISPLAY procedure.
An example of this is a fault which occurred as a "ground fault" prior to the last flight leg.
The alternate playback mode will show :
(1)Ground faults which have occurred in between flight legs.
(2)Faults which have occurred after an engine motor (dry or wet) with N2 greater than 18 %.
(3)Faults which occurred during any previous engine motors (dry or wet) with N2 greater than 18 %.
Example : If since the last flight, 3 dry cranks (N2 > 18 %) were performed with faults occurring in each ground run, the alternate playback mode will show ΔFL -XX, ΔFL -1, ΔFL -2 as those ground runs.

1. FADEC Ground Test

A. Reason for the Job
To display FADEC parametric data, status and maintenance words transmitted by each individual channel.

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
R - 22-23-00, P. Block 1	Flight Control Interface
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System-General

C. Procedure
(1)Job set-up
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that HP fuel shutoff valve control lever ENG1(2) is in OFF position.
(d)Make certain that ECAM system is operating (Ref. 31-51-00, P. Block 1).
(e)On overhead panel, place PITCH TRIM lever in ON position.
(f)Make certain that the following circuit breakers are closed.

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
22VU	FADEC/MODE WARN/ENG1	17KS	212/F22
133VU	ENGINES/ENG1/FUEL HP VALVE/CTL	3KC	333/T69
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68
133VU	ENG1-SCU SUPPLY-GND	35KS	333/T76
133VU	ENG1-SCU SUPPLY-FLT	37KS	333/T75
Engine 2			
22VU	FADEC/MODE WARN/ENG2	16KS	212/F23
133VU	ENGINES/ENG2/FUEL HP VALVE/CTL	4KC	333/T70
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68
133VU	ENG2-SCU SUPPLY-GND	34KS	333/T85
133VU	ENG2-SCU SUPPLY-FLT	36KS	333/T84

(2)Procedure for "GROUND TEST"
NOTE : Following this test the control returns to its normal mode ready for engine operation.
(a)On maintenance Panel 472VU :
(Ref. Fig. 501)
1 Place FADEC ENG1/ENG2 switch in ENG1(2) position
2 Place FADEC/BITE DISPLAY/TEST/OFF switch in "TEST" position
3 Wait 30 seconds
4 FADEC parametric data are displayed on the right ECAM display

unit.
- FADEC status words (Labels 270 thru 274) and FADEC maintenance words (Labels 350 thru 354) are displayed on the left ECAM display unit with their corresponding hexadecimal values for both channel A and channel B of the preselected ENG/FADEC.
- This display shows the present condition of the FADEC system.

(b)Convert hexadecimal display to binary form using table 501.

1 For maintenance words (Labels 350 to 354)
- Identify the bits which are set to "1" and therefore significant. Ref. TSM 73-21-40 to perform corrective action for fault.
- All the other bits remaining at "0" are not significant.

2 For status words (Labels 270 to 274)
- Refer to table 502 for identification of normal bits condition.
- Check especially the correct engine rating configuration through the 21 to 24 bit pattern of label 271.
  CAUTION : VERIFY THAT ANNUNCIATOR CIRCUIT (LABEL BIT 272-29) IS OPERATIONAL.
- Verify that annunciator circuit is operational (Label/Bit 272-29 is set = 1). If 272-29 is set = 0, perform corrective action for fault (Ref. TSM 73-21-40).
- Refer to TSM 73-21-40 for fault signification of bits in abnormal condition.

(c)Observe the present parametric values on the right ECAM display unit.

(d)Example
(Ref. Fig. 502, 503) and (Ref. Table 501)

On table 502, Identify a fault for label 350 (channel A)

LEFT HEX DIGIT	BITS 29	28	27	26	HEX DIGIT	BITS 25	24	23	22	HEX DIGIT	BITS 21	20	19	18	RIGHT HEX DIGIT	BITS 17	16	15	14
5	0	1	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0

In this example bits 18, 22, 26 and 28 are set to "1", therefore label/bits are 350-18, 350-22, 350-26 and 350-28.
(See TSM 73-21-40 for fault or faults identified by these bits).

LEFT HEX DIGIT	BITS 29	28	27	26	HEX DIGIT	BITS 25	24	23	22	HEX DIGIT	BITS 21	20	19	18	RIGHT HEX DIGIT	BITS 17	16	15	14
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1
2	0	0	1	0	2	0	0	1	0	2	0	0	1	0	2	0	0	1	0
3	0	0	1	1	3	0	0	1	1	3	0	0	1	1	3	0	0	1	1
4	0	1	0	0	4	0	1	0	0	4	0	1	0	0	4	0	1	0	0

LEFT HEX DIGIT	BITS 29	28	27	26	HEX DIGIT	BITS 25	24	23	22	HEX DIGIT	BITS 21	20	19	18	RIGHT HEX DIGIT	BITS 17	16	15	14
5	0	1	0	1	5	0	1	0	1	5	0	1	0	1	5	0	1	0	1
6	0	1	1	0	6	0	1	1	0	6	0	1	1	0	6	0	1	1	0
7	0	1	1	1	7	0	1	1	1	7	0	1	1	1	7	0	1	1	1
8	1	0	0	0	8	1	0	0	0	8	1	0	0	0	8	1	0	0	0
9	1	0	0	1	9	1	0	0	1	9	1	0	0	1	9	1	0	0	1
A	1	0	1	0	A	1	0	1	0	A	1	0	1	0	A	1	0	1	0
B	1	0	1	1	B	1	0	1	1	B	1	0	1	1	B	1	0	1	1
C	1	1	0	0	C	1	1	0	0	C	1	1	0	0	C	1	1	0	0
D	1	1	0	1	D	1	1	0	1	D	1	1	0	1	D	1	1	0	1
E	1	1	1	0	E	1	1	1	0	E	1	1	1	0	E	1	1	1	0
F	1	1	1	1	F	1	1	1	1	F	1	1	1	1	F	1	1	1	1

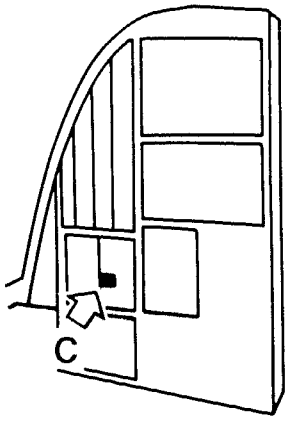
Control System Fault Isolation
Table Hex Word Conversion
Table 501

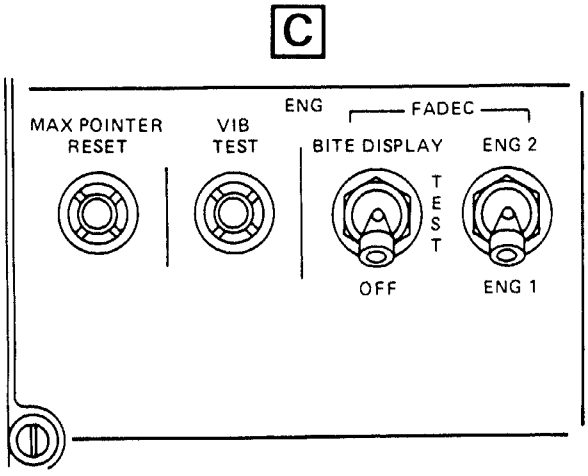
(3)Close-up
(a)Disengage the PITCH TRIM (Ref. 22-23-00, P. Block 1).
(b)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R D. PW415X Control System Trouble Shooting
R Serial Digital Data Bus Discrete Data During Ground Test
R (1)During the static ground test, the following discrete data bit patterns
R will be transmitted by the FADEC and displayed by the ECAM,
R IN THE ABSENCE OF FAULTS
R (2)In the following table, X = Variable Condition. Either state (0 or 1)
R could be valid.
R (3)Different cases of configuration :
R (a)271-23 : 0 and 271-22 : 1 and 271-21 : 0 = PW4152 engine.
R 271-23 : 0 and 271-22 : 1 and 271-21 : 1 = PW4158 engine.
R 271-23 : 1 and 271-22 : 0 and 271-21 : 1 = PW4156A engine.
R (b)272-29 : 0 = without Supplemental Control Unit (SCU).
R 272-29 : 1 = witht Supplemental Control Unit (SCU).
R (c)273-29 : 0 = with FADEC software prior to SCN10E.
R 273-29 : 1 = with FADEC software SCN10E and subsequent.
R (d)271-18 : 0 = segmented case compressor configuration.
R 271-18 : 1 = ring case compressor configuration.

	DISCRETE WORD	OCTAL LABEL	BIT POSITION 29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14
	FADEC Status Word #1	270	0	0	X	X	1	1	1	1	0	X	0	X	X	0	0	1
R	FADEC Status Word #2	271	X	X	X	X	X	0	X	X	X	0	0	X	X	X	0	0
R	FADEC Status Word #3	272	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	FADEC Status Word #4	273	X	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0
	FADEC Status Word #5	274	0	0	0	0	0	0	0	X	X	0	0	0	0	0	0	0
	FADEC Maint. Word #1	350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FADEC Maint. Word #2	351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FADEC Maint. Word #3	352	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FADEC Maint. Word #4	353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FADEC Maint. Word #5	354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

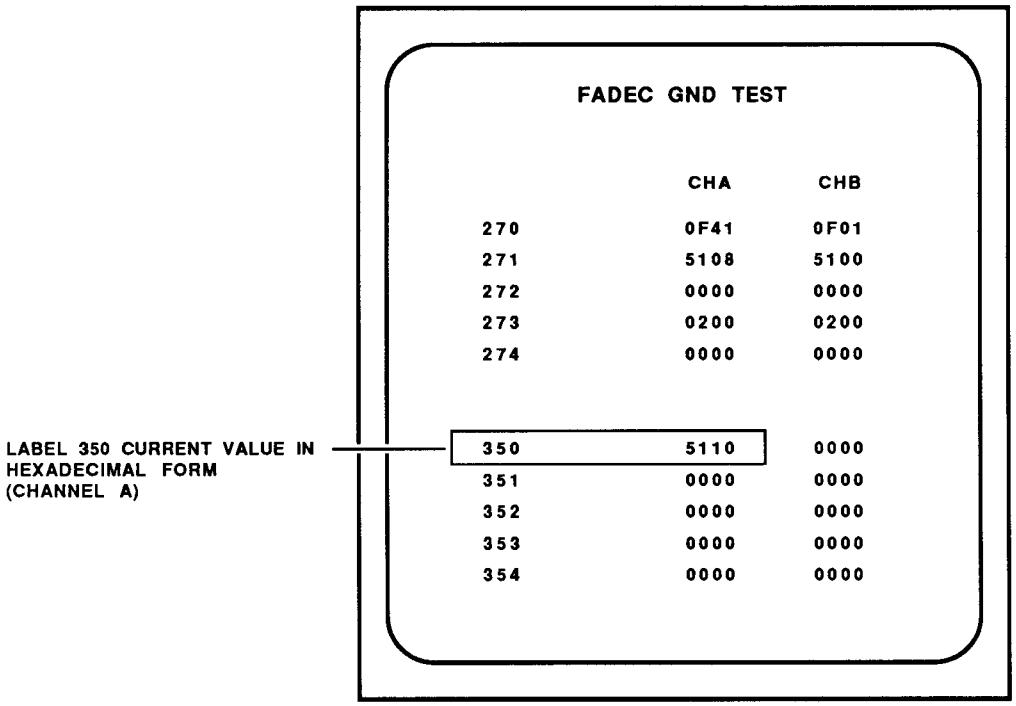
Table 502





BM5 73 38 00 5 KAMO · 22

FADEC Test - Maintenance Panel
Figure 501



NOTE :

HEXADECIMAL VALUE ARE INDICATED FOR EXAMPLE ONLY.

BM5 73 38 00 5 KCM0 01

FADEC Ground Test - Left ECAM Display Unit
Figure 502

RIGHT ECAM GROUND TEST DISPLAY

FADEC GRND TEST

	CHA	CHB
EPRTO	1.504	1.504
PAMB PSI	14.429	14.429
P2 PSI	14.430	14.430
PB PSI	14.50	14.50
P5 PSI	14.400	14.400
T2 °C	14.7	14.7
T3 °C	21.2	21.2
TF °C	25.1	25.1
TOIL °C	24.8	24.8
TRA DEG	37.0	37.0
SVA %	100.1	100.1
TCC %	1.2	1.2
AOHE %	100.0	100.0
B25 %	100.1	100.1
REV %	0.6	0.6

NOTE :

PARAMETRIC VALUE ARE INDICATED FOR EXAMPLE ONLY.

LEFT ECAM GROUND TEST DISPLAY

FADEC GND TEST

	CHA	CHB
270	1840	0680
271	5108	5100
272	0000	0000
273	0000	0000
274	0000	0000
350	0000	0000
351	0000	0000
352	0000	0000
353	0000	0000
354	0000	0000

NOTE :

HEXADECIMAL VALUE ARE INDICATED FOR EXAMPLE ONLY.

DISPLAY OF THE CONTENTS OF THE STATUT WORDS (LABELS 270 TO 274) AND THE MAINTENANCE WORDS (LABELS 350 TO 354).
THE DATA IS PROVIDED WITH FLAGS (AMBER X's) IF THE CORRESPONDING LABEL IS NOT GENERATED

Left and Right ECAM Ground Test Display
Figure 503

R

2. FADEC BITE Display - Past Flight Legs and Most Recent Ground Leg

A. Reason for the Job
To retrieve and display fault messages which occurred :
(1)During the last flight leg.
(2)During any previous flight legs.
(3)During the last engine shutdown (engine fuel off to N2 = 18 %).
(4)Last dry crank (N2 greater than 20 %).
(5)For scheduled maintenance (Ref. Engine Manual 05-10-00 para 7.).

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
R - 22-23-00, P. Block 1	Flight Control Interface
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System-General

C. Procedure
(1)Job set-up
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that HP fuel shutoff valve control lever ENG1(2) is in OFF position.
(d)Make certain that ECAM system is operating (Ref. 31-51-00, P. Block 1).
R (e)On overhead panel, place the PITCH TRIM lever in ON position.
R (f)Make certain the throttle control levers are at the idle position.
R (g)Make certain that the following circuit breakers are closed.

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
22VU	FADEC/MODE WARN/ENG1	17KS	212/F22
133VU	ENGINES/ENG1/FUEL HP VALVE/CTL	3KC	333/T69
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68
133VU	ENG1-SCU SUPPLY-GND	35KS	333/T76
133VU	ENG1-SCU SUPPLY-FLT	37KS	333/T75
Engine 2			
22VU	FADEC/MODE WARN/ENG2	16KS	212/F23
133VU	ENGINES/ENG2/FUEL HP VALVE/CTL	4KC	333/T70
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68
133VU	ENG2-SCU SUPPLY-GND	34KS	333/T85
133VU	ENG2-SCU SUPPLY-FLT	36KS	333/T84

(2)Procedure for FADEC BITE Display
CAUTION : PRIOR TO PLACING FADEC BITE DISPLAY/TEST/OFF SWITCH IN BITE

DISPLAY POSITION, VERIFY THAT LABEL/BIT 350-26 IS NOT SET = 1 IN EITHER CHANNEL OF BOTH FADECS (FADEC UNDER TEST ONLY, IF OTHER FADEC IS NOT POWERED). IF 350-26 IS SET = 1 IN ANY CHANNEL, PERFORM CORRECTIVE ACTION FOR THAT FAULT (SEE TSM 73-21-40 BEFORE PERFORMING BITE TEST).
FAILURE TO DO THIS MAY RESULT IN LOSS OF FADEC STORED FAULT INFORMATION.

(a)Place the FADEC ENG1/ENG2 switch in ENG1 (2) position.
(b)Place the FADEC BITE DISPLAY/TEST/OFF switch in the TEST position.
(c)Verify that Label-bit 350-26 (Data entry plug not installed) is "0" in both channels of the FADEC.
If 350-26 is set = 1 in either channel, perform corrective action for that fault before performing "BITE-Test" (Ref. TSM 73-21-40).
NOTE : FADEC BITE display is not possible for five minutes following shutdown of the engine.
This lock-out of the FADEC BITE display can be defeated by cycling the HP fuel shut off valve control lever for the desired engine.
This action will momentarily de-power the FADEC, causing the lockout to be released.
(d)Move the FADEC BITE DISPLAY/TEST/OFF switch to the BITE DISPLAY position and then back to the TEST position. The left ECAM will display the most recent faults.
(e)Review the data displayed on ECAM and do the following :
1 If there are no retrievable faults, all hexadecimal values for maintenance words 350-354 will be "0" and the ΔFL will be "0". No additional interrogation is required.
2 If there are retrievable faults, some hexadecimal values for maintenance words 350-354 will be non-zero and the ΔFL will be some value other than "0" (example : -1, -2, XX etc.). Record the label (350-354) and its associated hexadecimal values.
NOTE : In the BITE Display Mode :
Status words on the left ECAM will be displayed as "XXXX".
Parametric information on right ECAM will be displayed as "XXXX" (Ref. Fig. 504).
ΔFL -XX :
- Indicates ground faults stored during the last engine shutdown (after fuel off).
- Indicates ground faults stored during the last ground run, if no flight occurred since that time.
- Indicates ground faults stored during the last motor (dry or wet) with N2 greater than 18 %, if no flight occurred since that time.
ΔFL -1 indicates faults stored during the last flight-leg
ΔFL -2 indicates faults stored 2 flight-legs ago
ΔFL -3 indicates faults stored 3 flight-legs ago
ΔFL 0 indicates there are no additional faults to review.
(f)To review previous flight legs, cycle the FADEC BITE DISPLAY/TEST/OFF switch from the TEST position to BITE DISPLAY and then back to the TEST position.
Each time this cycle is performed, the FADEC will step back to an older flight leg data for maintenance words 350-354.

NOTE : FADEC channel A and FADEC channel B retrieve faults independently. It is possible for faults from 2 different flight legs to be displayed at the same time.
Example : Channel A may show ΔFL -1, while Channel B shows ΔFL -3.

NOTE : You may continue to cycle the FADEC BITE DISPLAY/TEST/OFF switch until all recorded faults have been reviewed or the switch is moved to the OFF position.
Once all of the faults have been reviewed, all hexadecimal values for maintenance words 350-354 will be "0". In addition, the ΔFL will be "0".

NOTE : After ΔFL 0 has been reached, continued cycling of the FADEC BITE DISPLAY/TEST/OFF switch will not change the hexadecimal values displayed.

(g) Convert the hexadecimal values recorded to binary form using the same procedure as for ground test (Ref. Table 501).

(h) Return the FADEC test switch back to the OFF position and for faults identification and troubleshooting instructions (Ref. TSM 73-21-40).

(i) After completing the required troubleshooting, place the FADEC test switch back to the TEST position, wait 30 seconds (minimum), and verify that all maintenance words (350-354) appear as zeros. This display shows the current condition of the system.

(j) If faults appear, repeat step (b) until no faults appear.

(k) If required, perform the BITE test in alternate playback mode at this time.

(3) Close-up

(a) Disengage the PITCH TRIM (Ref. 22-23-00, P. Block 1).

(b) De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

RIGHT DISPLAY

FADEC GRND TEST

	CHA	CHB
EPRTO	XXXX	XXXX
PAMB PSI	XXXX	XXXX
P2 PSI	XXXX	XXXX
PB PSI	XXXX	XXXX
P5 PSI	XXXX	XXXX
T2 °C	XXXX	XXXX
T3 °C	XXXX	XXXX
TF °C	XXXX	XXXX
TOIL °C	XXXX	XXXX
TRA DEG	XXXX	XXXX
SVA %	XXXX	XXXX
TCC %	XXXX	XXXX
AOHE %	XXXX	XXXX
B25 %	XXXX	XXXX
REV %	XXXX	XXXX

NOTE :

PARAMETRIC VALUE ARE INDICATED FOR EXAMPLE ONLY.

LEFT DISPLAY

FADEC GND TEST

	CHA	CHB
270	XXXX	XXXX
271	XXXX	XXXX
272	XXXX	XXXX
273	XXXX	XXXX
274	XXXX	XXXX
350	0010	0010
351	0000	0004
352	0000	0000
353	0000	0000
354	0000	0000
ΔFL	−1	−1

NOTE :

HEXADECIMAL VALUE ARE INDICATED FOR EXAMPLE ONLY.

BM5 73 38 00 5 KJM0 01

FADEC BITE Display - ECAM Display
Figure 504

**ON A/C 101-200,

R Post SB 73-2029 For A/C 101-200,

3. Alternate Playback Mode : Ground Legs Only

A. Reason for the Job
To retrieve and display fault messages from EEC memory which cannot be located by using the normal FADEC BITE DISPLAY procedure. An example of this is a fault which occurred as a "ground fault" prior to the last flight leg.
The alternate playback mode will show :
(1)Ground faults which have occurred in between flight legs.
(2)Faults which have occurred after an engine motor (dry or wet) with N2 greater than 18 %.
(3)Faults which occurred during any previous engine motors (dry or wet) with N2 greater than 18 %.
Example : If since the last flight, 3 dry cranks (N2 > 18 %) were performed with faults occurring in each ground run, the alternate playback mode will show ΔFL -XX, ΔFL -1, ΔFL -2 as those ground runs.

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 22-23-00, P. Block 1	Flight Control Interface
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System-General

C. Procedure
(1)Job set-up
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that HP fuel shutoff valve control lever ENG1(2) is in OFF position.
(d)Make certain that ECAM system is operating (Ref. 31-51-00, P. Block 1).
(e)On overhead panel, place the PITCH TRIM lever in ON position.
(f)Make certain that the following circuit breakers are closed.

**ON A/C 101-200,

R Post SB 73-2029 For A/C 101-200,

PANEL	SERVICE	IDENT.	LOCATION
Engine 1			
22VU	FADEC/MODE WARN/ENG1	17KS	212/F22
133VU	ENGINES/ENG1/FUEL HP VALVE/CTL	3KC	333/T69
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68
Engine 2			
22VU	FADEC/MODE WARN/ENG2	16KS	212/F23
133VU	ENGINES/ENG2/FUEL HP VALVE/CTL	4KC	333/T70
133VU	ENGINES/ENG1 & 2/START CTL & WARN	1KG	335/R68

**ON A/C 101-200,

R Post SB 73-2029 For A/C 101-200,

(g)Place throttle control system in position greater than 7.0 TLA (45° TRA).
(h)Press MODE SELECTOR pushbutton switch to command N1 mode (Ref. Fig. 505).
(2)Procedure in Alternate Playback Mode.
CAUTION : PRIOR TO PLACING FADEC BITE DISPLAY/TEST/OFF SWITCH IN BITE DISPLAY POSITION, VERIFY THAT LABEL/BIT 350-26 IS NOT SET = 1 IN EITHER CHANNEL OF BOTH FADECS (FADEC UNDER TEST ONLY, IF OTHER FADEC IS NOT POWERED). IF 350-26 IS SET = 1 IN ANY CHANNEL, PERFORM CORRECTIVE ACTION FOR THAT FAULT (SEE TSM 73-21-40 BEFORE PERFORMING BITE TEST).
FAILURE TO DO THIS MAY RESULT IN LOSS OF FADEC STORED FAULT INFORMATION.
(a)Place the FADEC ENG1/ENG2 switch in ENG1(2) position.
(b)Place the FADEC BITE DISPLAY/TEST/OFF switch in the TEST position.
(c)Verify that Label-bit 350-26 (Data entry plug not installed) is "0" in both channels of the FADEC.
If 350-26 is set = 1 in either channel, perform corrective action for that fault before performing "BITE-Test" (Ref. TSM 73-21-40).

**ON A/C 101-200,

R Post SB 73-2029 For A/C 101-200,

NOTE : FADEC BITE display is not possible for five minutes following shutdown of the engine.
This lock-out of the FADEC BITE display can be defeated by cycling the HP fuel shut off valve control lever for the desired engine. This action will momentarily de-power the FADEC, causing the lockout to be released.

**ON A/C 101-200,

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(d)Move the FADEC BITE DISPLAY/TEST/OFF switch to the BITE DISPLAY position and then back to the TEST position. The left ECAM will display the most recent faults.

(e)Review the data displayed on ECAM and do the following :

1 If there are no retrievable faults, all hexadecimal values for maintenance words 350-354 will be "0" and the ΔFL will be "0". No additional interrogation is required.

2 If there are retrievable faults, some hexadecimal values for maintenance words 350-354 will be non-zero and the ΔFL will be some value other than "0" (example : -1, -2, XX etc.). Record the label (350-354) and its associated hexadecimal values.

NOTE : In the BITE Display Mode :
Status words on the left ECAM will be displayed as "XXXX".
Parametric information on right ECAM will be displayed as "XXXX" (Ref. Fig. 504).

ΔFL -XX :
- Indicates ground faults stored during the last engine shutdown (after fuel off).
- Indicates ground faults stored during the last ground run, if no flight occurred since that time.
- Indicates ground faults stored during the last motor (dry or wet) with N2 greater than 18 %, if no flight occurred since that time.

ΔFL -1 indicates faults stored 2 ground runs ago
ΔFL -2 indicates faults stored 3 ground runs ago
ΔFL -3 indicates faults stored 4 ground runs ago
ΔFL 0 indicates there are no additional faults to review.

NOTE : In alternate playback mode, faults which occurred during any given flight will NOT be displayed. Alternate playback mode gives only faults which have occurred on the ground.

(f)To review previous ground legs, cycle the FADEC BITE DISPLAY/TEST/OFF switch from the TEST position to BITE DISPLAY and then back to the TEST position.
Each time this cycle is performed, the FADEC will step back to older ground leg data for maintenance words 350-354.

NOTE : FADEC channel A and FADEC channel B retrieve faults independently. It is possible for faults from 2 different ground legs to be displayed at the same time.
Example : Channel A may show ΔFL -1, while Channel B shows : ΔFL -3.

NOTE : You may continue to cycle the FADEC BITE DISPLAY/TEST/OFF switch until all recorded faults have been reviewed or the switch is moved to the OFF position.
Once all of the faults have been reviewed, all hexadecimal values for maintenance words 350-354 will be "0". In addition, the ΔFL will be "0".

NOTE : After ΔFL 0 has been reached, continued cycling of the FADEC BITE DISPLAY/TEST/OFF switch will not change the hexadecimal values displayed.

(g) Convert the hexadecimal values recorded to binary form using the same procedure as for ground test (Ref. Table 501).

(h) Return the FADEC test switch back to the OFF position and for faults identification and troubleshooting instructions (Ref. TSM 73-21-40).

(i) After completing the required troubleshooting, place the FADEC test switch back to the TEST position, wait 30 seconds (minimum), and verify that all maintenance words (350-354) appear as zeros. This display shows the current condition of the system.

(j) If faults appear, repeat step (h) until no faults appear.

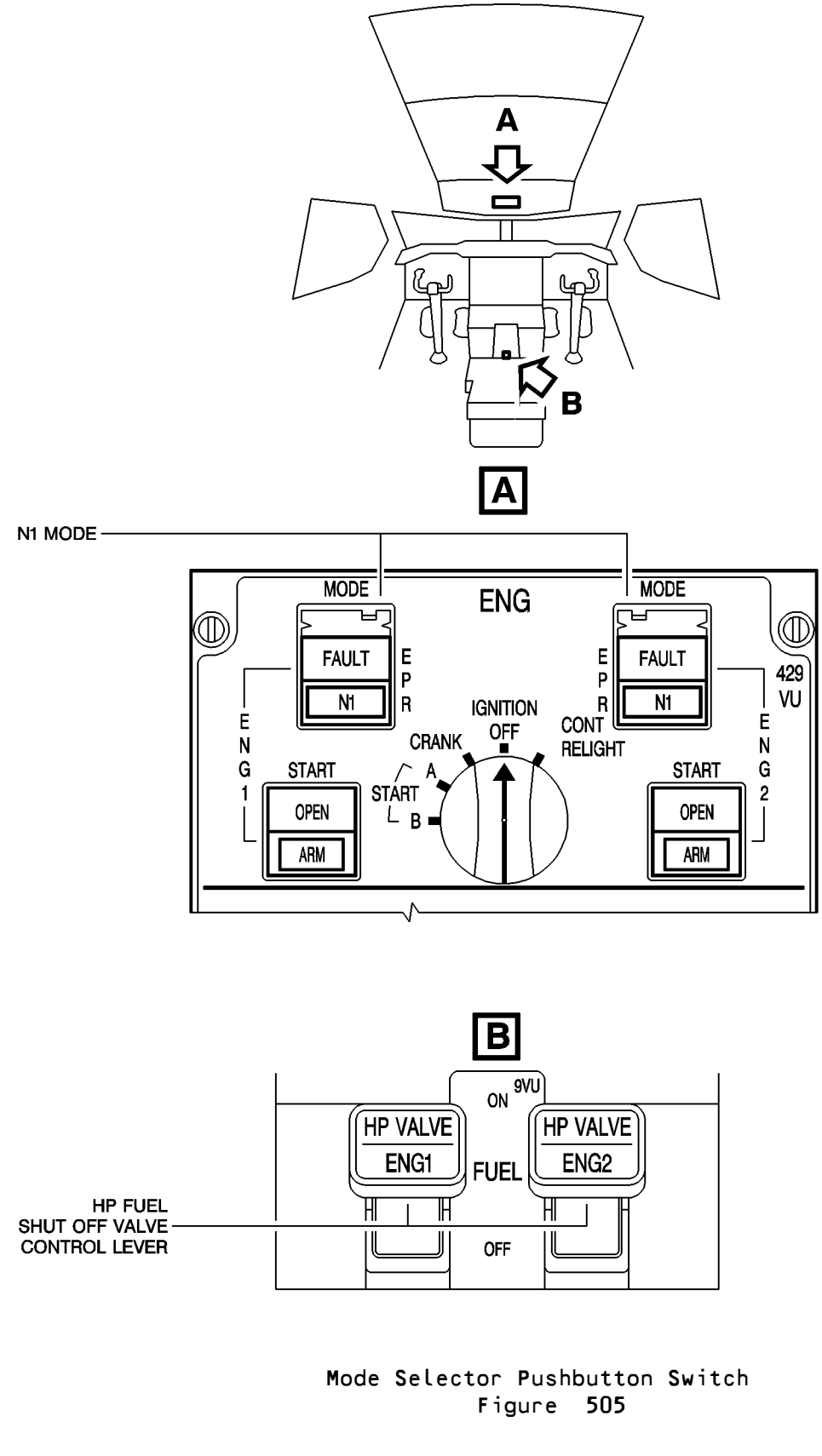
(3) Close-up

(a) Return throttle control levers to IDLE position.

(b) Release MODE SELECTOR pushbutton switch to return to EPR mode.

R (c) Disengage the PITCH TRIM (Ref. 22-23-00, P. Block 1).

(d) De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).



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Mode Selector Pushbutton Switch
Figure 505